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KELP FOREST MONITORING  
1994 Annual Report

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## EXECUTIVE SUMMARY

Channel Islands National Park has conducted long-term ecological monitoring of the kelp forests around Santa Barbara, Anacapa, Santa Cruz, Santa Rosa, and San Miguel Islands since 1982. Permanent transects were established at 16 stations between 1981 and 1986. In 1994, the stations were monitored during seven five-day cruises between June and September. One four-day cruise in January, and a two-day cruise in March were conducted to retrieve and redeploy temperature loggers. The 1994 kelp forest monitoring was completed by 40 National Park Service (NPS) and volunteer divers completing a total of 852 dives.

Divers using SCUBA or surface-supply air completed all quadrats, band transects, random point contacts, size frequencies, artificial recruitment modules, fish and video transects during 1994. Line repair was completed as necessary at all locations. Channel Islands National Marine Sanctuary provided funding to purchase additional temperature loggers with increased memory capacity. These loggers will enable us to collect temperature data at all sites without data gaps.

In 1994, giant kelp, *Macrocystis pyrifera*, forests were present at 13 of the 16 sites. These included all sites at Santa Barbara, Anacapa, and Santa Rosa Islands, as well as Yellow Banks, Gull Island, and Pelican Bay at Santa Cruz Island, and Wyckoff Ledge at San Miguel Island. Scorpion Anchorage on Santa Cruz Island, remains barren with little algae, and high densities of purple urchins, *Strongylocentrotus purpuratus*. Hare Rock on San Miguel Island was still dominated by red sea urchins, *S. franciscanus*. Fry's Harbor on Santa Cruz Island had some understory brown algae, but continued to be dominated by small aggregated red sea cucumbers, *Pachythyone rubra*.

Artificial Recruitment Modules (ARMs) are now present at 10 of the 16 Kelp Forest sites. This year, size frequency measurements were conducted for bat stars, *Patiria miniata*, giant-spined sea stars, *Pisaster giganteus*, sunflower stars, *Pyncopodia helianthoides*, red sea urchins, *Strongylocentrotus franciscanus*, purple sea urchins, *S. purpuratus*, white sea urchins, *Lytechinus anamesus*, chestnut

cowries, *Cypraea spadicea*, wavy top turban snails, *Astraea undosa*, rock scallops, *Hinnites giganteus*, and abalone, *Haliotis spp.* at all ten locations with ARMs. In the ARMs, red and purple sea urchin recruitment increased at five sites, decreased at two, and remained the same at two. Although there are no ARMs at the Santa Barbara Island sites, large numbers of purple sea urchins were observed, especially at Southeast Sea Lion Rookery.

Abalone recruitment around the monitoring sites was low. We observed few abalone less than 26 mm in their natural environment, and in the ARMs. Although red abalone (greater than 26 mm) were common at Wycoff Ledge, fresh shells were relatively abundant. We received reports of red abalone with withering syndrome from San Miguel and Santa Rosa Islands. Pink abalone were relatively common at Admiral's Reef and Landing Cove on Anacapa Island. At these sites, fresh pink abalone shells were relatively abundant, but no abalone with withering syndrome were observed.

Wasting disease was observed in bat stars, *Patiria miniata*, rainbow stars, *Astometis sertulifera*, and the giant-spined sea star, *Pisaster giganteus* at Pelican Bay, Santa Cruz Island. Sea urchin wasting syndrome was observed in purple sea urchins, *Strongylocentrotus purpuratus*, and/or white sea urchins *Lytechinus anamesus* at Gull Island South, Fry's Harbor, Pelican Bay, and Scorpion Anchorage on Santa Cruz Island, Admiral's Reef and Landing Cove on Anacapa Island, and at Southeast Sea Lion Rookery on Santa Barbara Island.

The National Oceanographic and Atmospheric Administrations El Niño Advisories (NOAA, 1994) indicated that the waters around the Channel Islands were 1.0 - 3.0 °C above average from January - July, 1994. During our January cruise, pelagic red crabs were observed at Talcott Shoal, Santa Rosa Island. In 1994, this was our only sighting of a species often associated with El Niño conditions. The July issue of the Advisory stated that there had been a gradual return to near normal temperature conditions since the 1992 - 1993 El Niño.

## INTRODUCTION

The waters of Channel Islands National Park and Channel Islands National Marine Sanctuary contain one-third of southern California's kelp forests (Davies, 1968). The brown algae, *Macrocystis pyrifera*, is the primary constituent of these kelp forests and over 1,000 species of macro flora and fauna can be found here (Woodhouse 1981, J. M. Engle pers. comm.). Many other species, while not residents of the kelp forest community, are dependent upon the existence and productivity of kelp forests. The kelp forest serves as food, shelter, substrate, and nursery to resident as well as migratory species. Kelp forest detrital flux provides an important source of nutrients to nearby rocky shore, sandy beach, and estuary communities. The kelp forests are essential to our commercial and sport fisheries as well as recreation and the associated tourist industry.

Channel Islands National Park consists of five of the eight California Channel Islands (San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara) and the submerged lands and waters within one nautical mile of each of the islands. The Channel Islands National Marine Sanctuary overlaps the subtidal portions of the park, and its boundary extends six miles seaward from the park islands. Channel Islands National Park also bears the designation of International Biosphere Reserve and State of California Areas of Special Biological Significance. The State of California maintains jurisdiction over the park's marine resources and manages them through the Department of Fish and Game.

The federal law which established Channel Islands National Park (16-USC-410) mandated the development of inventories and monitoring of natural resources in the park. Kelp forest monitoring is part of the long-term ecological monitoring program at the park which is designed to measure the health of the ecosystems. By determining the limits of normal variation and diagnosing abnormal conditions we hope to prescribe remedial action through management recommendations.

Following a five year design study begun in 1982, the kelp forest monitoring program was implemented

in 1987 by the Park's resource management division, using the protocol established during the design phase. Monitoring design rationale is discussed in Davis and Halvorson (1988). Preliminary results and specific design considerations can be found in reports written by Davis (1985, 1986). Richards, Gramlich, and Davis (in prep.), describe monitoring efforts and results for 1982-1989. Richards, Avery, and Kushner (1993), Richards, Kushner, and Avery (1993), Richards and Kushner (1994), and Kushner et. al. (1995) describe the 1990, 1991, 1992, and 1993 monitoring efforts and results respectively.

This report summarizes the monitoring efforts and results from 1994, our thirteenth year of monitoring. It is hoped that these reports will provide some insight into kelp forest dynamics and stimulate further research into the long-term trends and changes in the nearshore ecosystem. We have highlighted some of the most important observations, and tried to provide a characterization for each site. Organisms are referred to by genus and species, except in the abstract and executive summary where both scientific and common names are used. Common names are cross referenced to their scientific names in Table 1. Since the design of the kelp forest monitoring project several genus and species names have been changed. Their original names have been used in this text, and the new names are cross referenced in Table 1.

## METHODS

Population dynamics of 68 taxa or categories of algae, fish, and invertebrates (Table 1) were measured at 16 permanent sites (Table 2) around the five park islands (Fig. 1). Site and species selection criteria are provided in the Kelp Forest Monitoring Handbook (Davis, 1988). Sites were monitored between January and September of 1994.

Each site is marked by a 100 m long transect permanently affixed to the seabed. The sampling

techniques employed to gather information on population dynamics are summarized in Table 3. At each station, 20 randomly placed 1 m x 2 m quadrats and 12 randomly placed 3 m x 20 m band transects were used to determine densities and distribution of discrete benthic organisms; 1000 random non-adjacent points (random point contacts - RPCs) were used to determine percent cover of encrusting invertebrates, algae, and substrate composition; 2 m x 3 m x 100 m fixed transects were used to determine fish abundance; video taped transects provide a record of the site appearance; and size frequency measurements were collected to determine age structure, population recruitment, and growth rates. A general species list was established for each site, noting presence/absence and relative abundance for all recognizable species (Species list data was collected during the normal summer sampling cruises as well as on the January cruise this year). Artificial recruitment modules were used at ten of the sites to measure recruitment and population structure. Documentary still photographs were taken at Cathedral Cove on Anacapa Island, and Southeast Sea Lion Rookery on Santa Barbara Island.

Animals measured for the natural size frequency distributions were located using a band transect type search method, in a few cases the general search method, and quadrats were used to locate sea urchins at Southeast Sealion. The method used for each target species is listed at the top of each distribution in appendix A. The band transect type search method is when a diver swims approximately 5-10 m X 2 arms length transects perpendicular to the main transect. These transects are spaced approximately 5-10 m along the main transect depending on the abundance of the target species. The general search method is when a diver swims in the area around the transect and measures all the emergent animals of the target species they encounter. All methods of sampling are non-destructive (the substrate is undisturbed, and only emergent animals are measured), except sea urchins are removed so that any sea urchins hiding under their spine canopy can be measured.

In addition to the standard size frequency measurements, size frequency measurements in the artificial recruitment modules (ARMs) were also collected. These ARMs are rock cribs, consisting of 20 half-



sized concrete blocks (40cm L X 20cm W X 10cm H) stacked five high and enclosed in a wire mesh frame. The wire cage dimensions are 60cm L X 60cm W X 50cm H and the mesh size is 5cm X 10 cm. The ARMs provided a standardized surface area of about 24 m<sup>2</sup>. The ARMs are sampled by opening up the cage, and removing each brick while looking for animals. Animals measured included: *Patiria miniata*, *Pisaster giganteus*, *Pycnopodia helianthoides*, *Strongylocentrotus franciscanus*, *S. purpuratus*, *Lytechinus anamesus*, *Cypraea spadicea*, *Astraea undosa*, *Hinnites giganteus*, and *Haliotis spp.*. Due to time constraints underwater, when more than 200 individuals of a particular species were measured, we sometimes discontinued measuring that species in the remaining ARMs at the site. Measurements were taken underwater, or the animals were brought to the surface to be measured then replaced into the ARM they were removed from. The number of ARMs from which a particular species were measured is listed at the top of their distribution in Appendix A.

Temperature data were collected at all 16 sites using HOBOTEMP<sup>tm</sup> and STOWAWAY<sup>tm</sup> temperature loggers, which are attached to stainless steel thread rods cemented to bottom at each site. The HOBOTEMP loggers were programmed to record temperature every 4.8 hours, and the STOWAWAY loggers were programmed to record the mean temperature of 100 temperature readings per hour. Because our sampling is conducted June - September we have decided to present 12 months of temperature data from June 1, 1993 to May 31, 1994. During this period, only the HOBOTEMP<sup>tm</sup> loggers were deployed.

## STATION RESULTS AND DISCUSSION

Sampling was completed at all 16 monitoring sites by 40 divers (Table 5) during seven five-day cruises between June and September. One four-day cruise in January, and a two-day cruise in March were conducted to retrieve and redeploy temperature loggers. Species list surveys were also conducted during the January cruise. A total of 852 dives with 676 hours of bottom time were completed.

A brief description of each site is included with the station results below. Means for quadrats, band transects, random point contacts, fish transects, and size frequency tables for each location are in appendix A. Size frequency measurements from the artificial recruitment modules were kept separate from the natural habitat measurements and are identified as such in appendix A. Species lists for all locations are in appendix B. The temperature data collected by the temperature loggers is presented in graphic form for each site where data was available in appendix C. The amount of temperature data varies for each station, dependent on deployment dates and operation of the temperature logger. Video transects were completed for all locations. A summary of the 1994 status of each site is presented in Table 4. Unless specifically noted, observations in these sections are from the summer survey period.

**Location: Wyckoff Ledge, San Miguel Island**

**Site #1 SMIWL**

1994 sampling dates: 1/19, 7/12, 9/27

1994 status: dense, mature kelp forest

*Macrocystis pyrifera* canopy cover was thick and covered 100% of the transect, although in January, canopy cover was estimated at only 15%. The *M. pyrifera* appeared healthy and had few epiphytes growing on the blades. Many of the adult *M. pyrifera* plants were very large, but small plants were also common. Adult *M. pyrifera* density was 0.38/m<sup>2</sup>. Juvenile *M. pyrifera* were common with a density of 0.45/m<sup>2</sup>. *M. pyrifera* coverage on the bottom was 24%. Low light conditions occurred on the bottom because of the thick canopy. Understory foliose algae was abundant. Miscellaneous red algae covered 65% of the bottom, and consisted mostly of the red algae, *Cryptopleura violacea*. *Gigartina* spp. covered an additional 6.4% of the bottom and consisted mostly of *G. corymbifera*. *Cystoseira* spp. was common and covered 7.9% of the bottom. *Desmarestia* spp. covered 1.2% of the bottom and consisted of *D. ligulata* var. *firma*. Articulated and encrusting coralline algae covered 14% and

25% of the bottom respectively.

Hydroids, and the worm, *Pista elongata* were the most common miscellaneous invertebrates on RPCs. This category covered 12% of the bottom. Bryozoans were common, covering 14% of the bottom. *Phragmatopoma californica* covered 6.4% of the bottom, and were common on rocks near sandy areas and in most *Macrocystis pyrifera* holdfasts. *Diopatra ornata* were common, covering 11% of the bottom. Tunicates encrusting the tops of rocks were common, and consisted mostly of *Cystodytes lobatus*. Approximately 75% of the temperature logger housing was covered with *C. lobatus* during the nine months it was deployed. Overall, sponges were common covering 2.1% of the bottom. *Tethya aurantia* were abundant, with a density of  $0.11/\text{m}^2$ . *Telia lofotensis* were abundant having a density of  $0.27/\text{m}^2$ . *Balanophyllia elegans* were common, covering 1.9% of the bottom.

Mysids were abundant on the bottom, and the kelp isopod, *Idotea resecata*, were common in the kelp canopy. The kelp crab, *Pugettia producta*, was also common in the kelp canopy. *Kelletia kelletii* were abundant having a density of  $0.44/\text{m}^2$ . *Astraea gibberosa* were relatively abundant on the east half of the transect. *Haliotis rufescens* were common in crevices, but only three were observed on band transects ( $0.0042/\text{m}^2$ ). On January 19, seven fresh *Haliotis rufescens* shells were found near the transect. Three small (<50mm) abalone were observed in January.

*Patiria miniata* were abundant having a density of  $2.1/\text{m}^2$ . *Pisaster giganteus* were common on the rocky outcrops near the transect. Their density along the transect was  $0.25/\text{m}^2$ . *Pycnopodia helianthoides* were uncommon with a density of  $0.0083/\text{m}^2$ . *Strongylocentrotus purpuratus* were relatively uncommon and *S. franciscanus* were common. Both species were patchy and mostly in crevices. Their densities were  $0.38/\text{m}^2$  and  $0.45/\text{m}^2$  respectively.

Overall, fish were abundant at this site. *Gibbonsia* spp. (kelpfish), *Sebastes caurinus* (copper rockfish), and *S. atrovirens* were abundant. *S. mystinus*, *S. miniatus* (vermillion rockfish), *Oxylebius*

*pictus* (painted greenlings), *Semicossyphus pulcher*, and *Oxyjulis californicas* were all common. Two *Ophiodon elongatus* (lingcod), several *Pleuronichthys coenosus* (c-o turbot), one *Paralichthys californicus* (California halibut), and one *Cephaloscyllium ventriosum* (swell shark) were observed. *S. mystinus* and *S. atrovirens* were observed feeding on a small school of small *Engraulis mordax* (Northern anchovies) above the transect.

**Location: Hare Rock, San Miguel Island**

**Site #2 SMIHR**

1994 sampling dates: 1/20, 7/13, 9/27

1994 status: *Strongylocentrotus franciscanus* barren

This site continued to be dominated by *Strongylocentrotus franciscanus*. There were several canopy forming *Macrocystis pyrifera* plants east of the east end of the transect, and two large plants located about 5 m north of the transect at 40 m. These *M. pyrifera* plants appeared healthy, but had an abundance of *S. purpuratus* and *S. franciscanus* around their holdfasts. Most of the bottom was either bare (38%) or covered with encrusting coralline algae (34%).

*Corynactis californica*, *Balanophyllia elegans*, and *Astrangia lajollaensis* were abundant. They covered 7.5%, 3.3% and 1.5% of the bottom respectively. Terebellid worms and *Balanus sp.* (barnacles) were the most common miscellaneous invertebrates on RPCs. This category covered 12% of the bottom. *Balanus sp.* almost completely covered the bottom between 90 and 100 m, and were scattered throughout the rest of the transect. *Pisaster giganteus* were observed feeding on the *Balanus sp.*, and *Balanus sp.* shell fragments covered the bottom along the entire transect. Mysids were abundant on the bottom.

*Strongylocentrotus franciscanus* were abundant with a density of  $9.3/\text{m}^2$ . Small *S. franciscanus*

were common. *S. purpuratus* were relatively uncommon ( $0.85/\text{m}^2$ ), but small patches of moderate densities occurred. *Pisaster giganteus* and *Patiria miniata* were abundant. Their densities were  $1.3/\text{m}^2$  and  $1.9/\text{m}^2$  respectively. *Pycnopodia helianthoides* were common and had a density of  $0.065/\text{m}^2$ .

*Sebastes mystinus*, adult and juvenile *Sebastes atrovirens*, female *Semicossyphus pulcher*, and *Coryphopterus nicholsii* were common. Several *Sebastes caurinus* (copper rockfish), a *Sebastes serriceps* (reeffish), and a *Ophiodon elongatus* (lingcod) were seen. A small school of *Oxyjulis californica* was seen, and small groups of *Aulorhynchus flavidus* (tube snouts) were observed beneath the mysid swarms.

**Location: Castle Rock, San Miguel Island**

Latitude:  $34^{\circ} 03.01$  N. Longitude:  $120^{\circ} 26.60$  W.

1994 sampling dates: 1/20

We conducted a survey for *Haliotis rufescens* at this site. The general search method was used to locate *H. rufescens*. A total of 91 abalone were measured with a mean size of 127 mm (The size distribution for this survey is listed at the end of appendix A.). The survey was conducted at the depth range of 35-60 ft.. The bottom substrate consisted mostly of large boulders and rocky shelves. The area consisted of a mature kelp forest, with large, wide spread *Macrocystis pyrifera* plants forming a thick canopy.

**Location: Johnson's Lee North, Santa Rosa Island**

**Site #3 SRIJLN**

1994 sampling dates: 1/19, 7/27, 7/28, 9/14

1994 status: mature kelp forest

*Macrocystis pyrifera* was abundant, but canopy cover over the transect was estimated at 60%. In January, canopy cover was estimated at 90%. Adult and juvenile *M. pyrifera* plants were abundant. Their densities were 1.2/m<sup>2</sup> and 2.5/m<sup>2</sup> respectively. *M. pyrifera* coverage on the bottom was 40%. Most of the *M. pyrifera* appeared healthy, but some of the plants had epiphytes (mostly bryozoans) growing on them. Understory algae was abundant and consisted mostly of miscellaneous red algae (41%), *Cystoseira* spp. (16%), *Pterygophora californica* (11%), articulated coralline algae (9.7%), and *Laminaria farlowii* (1.3%). *P. californica* and *L. farlowii* densities were 0.5/m<sup>2</sup> and 0.1/m<sup>2</sup> respectively.

Hydroids (mostly *Aglaophenia latirostris*) and the worm *Pista elongata* were the most common miscellaneous invertebrates on RPCs. This category covered 21% of the bottom. *Phragmatopoma californica* were common, and were present in most *Macrocystis pyrifera* holdfasts. *P. californica* coverage was recorded at 8.2%. Bryozoans and tunicates were abundant and covered 30% and 9.8% of the bottom respectively. The most common tunicates were *Aplidium* spp., *Pycnoclavella stanleyi*, *Cystodytes lobatus*, and *Didemnum/Trididemnum*. *Styela montereyensis* were common with a density of 1.3/m<sup>2</sup>. Sponges were common and covered 3.2% of the bottom.

*Strongylocentrotus franciscanus* and *S. purpuratus* were mostly found in deep crevices and under ledges. Their densities were low, 0.28/m<sup>2</sup> and 0.45/m<sup>2</sup> respectively. *Patiria miniata* and *Pisaster giganteus* were common having densities of 0.43/m<sup>2</sup> and 0.33/m<sup>2</sup> respectively. *Pycnopodia helianthoides* were also common with a density of 0.019/m<sup>2</sup>, but most were small.

*Haliotis rufescens* were common under ledges and in crevices near the transect. Six *H. rufescens* were found on band transects resulting in a density of 0.0083/m<sup>2</sup>. The opisthobranch, *Navanax inermis*, and their eggs were common. Several *Astraea gibberosa* and *A. undosa* were observed.

Adult *Sebastes chrysomelas* (Black and yellow rockfish), *S. atrovirens*, *Embiotoca lateralis*, *Embiotoca jacksoni*, *Chromis punctipinnis*, and small female *Semicossyphus pulcher* were common. Several juvenile *Embiotoca jacksoni* were observed. Overall, juvenile fish were uncommon. Several *Sebastes serranoides* were seen, but none were observed on fish transects. *Paralabrax clathratus* were uncommon, and three *Hypsypops rubicundus* were seen along the transect. *Cephaloscyllium ventriosum* (Swell sharks) were seen, but were relatively uncommon compared to last year when they were abundant. None were observed in the ARMs this year.

Two of the original 15 ARMs were lost in 1993 at this site (Kushner et al, 1995). The five ARMs at the west end of the transect and the three ARMs at mid-transect were all intact. Two of five ARMs at the east end of the transect had their lids pried open, but were intact on our January 19th visit. Several of the brass tags had fallen off due to corrosion. Some were replaced, but several of the modules are without number tags.

In the 13 ARMs, six *Haliotis rufescens* were found. Five were native (18, 18, 29, 152, and 155 mm) and one was introduced (139 mm). *Hinnites giganteus* were relatively uncommon, eight were found in the ARMs this year. *Cypraea spadicia*, *Patiria miniata*, *Pisaster giganteus*, and *Pycnopodia helianthoides* were common. *Strongylocentrotus franciscanus* and *S. purpuratus* were common; 137 and 128 were found in the 13 ARMs.

**Location: Johnson's Lee South, Santa Rosa Island**

**Site #4 SRIJLS**

1994 sampling dates: 1/19, 7/28, 9/14

1994 status: mature kelp forest

*Macrocystis pyrifera* canopy covered 100% of the transect at slack tide. In January, canopy cover was estimated at 85%. Adult and juvenile *M. pyrifera* densities were  $0.4/\text{m}^2$  and  $0.2/\text{m}^2$  respectively, and covered 25% of the bottom. Understory red algae were abundant covering 41% of the bottom. *Laminaria farlowii* had a density of  $0.23/\text{m}^2$  and covered 2.2% of the bottom. Articulated and encrusting coralline algae covered 11% and 10% of the bottom respectively. Overall, this site appeared similar to last year.

Hydroids and the worm, *Pista elongata*, were the most common miscellaneous invertebrate on RPCs. This category covered 11% of the bottom. Amphipod tube mats were relatively uncommon compared to 1993. Bryozoans and *Balanophyllia elegans* were abundant covering 22% and 6.3% of the bottom respectively. *Astrangia lajollaensis* covered 2.3% of the bottom, and tunicates covered 5.3%. *Styela montereyensis* were common with a density of  $0.63/\text{m}^2$ . *Diopatra ornata* and *Phragmatopoma californica* covered 13% and 5.2% of the bottom respectively. *Lophogorgia chilensis*, *Telia lofotensis*, and *Tethya aurantia* had densities of  $0.14/\text{m}^2$ ,  $0.11/\text{m}^2$ , and  $0.12/\text{m}^2$  respectively.

*Strongylocentrotus franciscanus* and *S. purpuratus* continue to occur at low densities,  $0.2/\text{m}^2$  and  $0.6/\text{m}^2$  respectively. Most of the *Strongylocentrotus* spp. at this site were under ledges, or in crevices making them difficult to access for size frequencies measurements. *Pycnopodia helianthoides* and *Patiria miniata* were abundant with a densities of  $0.088/\text{m}^2$  and  $2.9/\text{m}^2$  respectively. *Pisaster giganteus* were common with a density of  $0.15/\text{m}^2$ .

*Haliotis rufescens* were relatively common, five ( $0.0069/\text{m}^2$ ) were found on band transects. *Hinnites giganteus* were common with a density of  $0.38/\text{m}^2$ .

Overall, fish were common at this site. *Chromis punctipinnis*, *Semicossyphus pulcher*, *Embiotoca jacksoni*, *Damalichthys vacca*, and *Sebastes atrovirens* were all common. *Oxyjulis californica* were abundant.



This year the seven ARMs were intact and upright. In July, we replaced most of the broken bricks. Bryozoans were abundant in the ARMs. All seven ARMs were monitored for index species. One 74 mm *Haliotis rufescens* was found. The mean size for *Hinnites giganteus* was 28 mm, and 11 were found. *Patiria miniata* were abundant with 94 being present in the ARMs. *Strongylocentrotus franciscanus* were common; 64 were found in the ARMs. *S. purpuratus* were uncommon, only 12 were found.

**Location: Rodes Reef, Santa Rosa Island**

**Site: #5 SRIRR**

1994 sampling dates: 1/20, 9/15, 9/16

1994 status: sparse/open kelp forest

*Macrocystis pyrifera* canopy cover over the site was estimated at 20% during both the January and September surveys. Adult and juvenile *M. pyrifera* densities were low, 0.075/m<sup>2</sup> and 0.0/m<sup>2</sup> respectively. Although there were no juvenile *M. pyrifera* in the quadrat counts there were several juvenile plants observed near the transect during the January and September surveys. Percent cover of *M. pyrifera* on RPC's was low, 0.7%. The adult *M. pyrifera* plants that were present along the transect were large and sparse. Most of the plants appeared unhealthy, having tattered fronds and moderate infestations of kelp curler amphipods. Understory red algae was abundant covering 69% of the bottom. *Laminaria farlowii* and *Cystoseira spp.* covered 0.9% and 1.0% of the bottom respectively. The eastern half of the transect appeared to have more sand than in previous years. Sand covered 20% of the transect, its highest recorded coverage at this site.

The most common miscellaneous invertebrates on RPCs were the worms *Chaetopterus variopedatus*, and *Pista elongata*. This category covered 30% of the bottom. *C. variopedatus* were abundant on the eastern half of the transect, and were found in clumps with red algae growing on top of them.

*Diopatra ornata* were common covering 7.1% of the bottom. *Tealia lofotensis*, *T. columbiana*, and *T. coriacea*, were common. *Balanophyllia elegans* and *Astrangia lajollaensis* were common covering 1.8% and 5.7% of the bottom respectively. *Tethya aurantia* were abundant having a density of 0.19/m<sup>2</sup>. Bryozoans covered 9.2% of the bottom.

Kelp isopods, *Idotea resecata*, were abundant on the stipes of the *Macrocystis pyrifera* plants. Clouds of mysids were common on the bottom.

*Patiria miniata*, *Pisaster giganteus*, and *Pycnopodia helianthoides* had densities of 1.7/m<sup>2</sup>, 0.18/m<sup>2</sup>, and 0.013/m<sup>2</sup> respectively. *Strongylocentrotus franciscanus* and *S. purpuratus* were increasingly common towards the western half of the transect where more hard substrate is present. Their densities were 2.8/m<sup>2</sup> and 0.93/m<sup>2</sup> respectively. A commercial sea urchin picking arm was found about five meters from the transect, indicating likely commercial harvest around the transect. In January three small *Haliotis rufescens* (<10mm) were observed under a rock that was covered with encrusting coralline algae. No adult *H. rufescens* have been found here in at least the past five years.

Large male and female *Semicossyphus pulcher* were abundant. *Sebastes mystinus*, *S. atrovirens*, *Paralabrax clathratus*, *Embiotoca jacksoni*, and *E. lateralis* were all common. Several *Caulolatilus princeps* (ocean whitefish) were seen.

**Location: Gull Island South, Santa Cruz Island**

**Site: #6 SCIGIS**

1994 sampling dates: 1/18, 7/11, 8/9, 8/10, 9/28

1994 status: mature kelp forest

In January, canopy *Macrocystis pyrifera* canopy cover was estimated at 85% and most of the plants

appeared healthy with few epiphytes growing on the fronds. In August, *M. pyrifera* canopy covered was estimated at 75% and the plants appeared unhealthy having tattered fronds with many epiphytic bryozoans growing on them. However, some healthy *M. pyrifera* plants were also present. Adult *M. pyrifera* density was  $0.45/\text{m}^2$ . Juvenile *M. pyrifera* was uncommon having a density of  $0.075/\text{m}^2$ . Overall, there was little understory algae. One *Eisenia arborea* was observed along the line and it appeared to be senescing. Miscellaneous red algae was common, covering 17% of the bottom. The green algae, *Codium setchellii* was relatively common. Articulated coralline was common on the tops of rock, but overall it was not very abundant covering 1.4% of the bottom. Crustose coralline algae was abundant covering 48% of the bottom.

On RPCs, the most common miscellaneous invertebrates were amphipod tube mats, hydroids, and the worm, *Pista elongata*. This category covered 26% of the bottom. Bryozoans were abundant and covered 23% of the bottom. The most common bryozoans were *Bugula californica*, *Phidilopora pacifica*, and *Diaperoecia californica*. *Lichenopora novae-zelandiae* and another encrusting bryozoan were common. In January, the bryozoan, *Bugula neritina* was abundant and appeared to be everywhere. Colonies of the worm, *Salmacina tribranchiata*, were abundant on rock ledges. Mysids were common on the bottom. *Balanophyllia elegans*, *Astrangia lajollaensis*, and *Paracyathus stearnsi* were all common. The cobalt blue sponge, *Hymenamphiastra cyanocrypta* and a encrusting red sponge were common. *Allopora californica* colonies were common with a density of  $0.031/\text{m}^2$ , and large colonies were common in the sea urchin barrens inshore of the transect.

*Strongylocentrotus purpuratus* were abundant on the north end of the transect and many small (less than 10 mm) individuals were present on the coralline algae encrusted rocky substrate. *S. purpuratus* density was  $14/\text{m}^2$ . There were few *S. purpuratus* along the transect compared to the shallow (<35 ft.) areas inshore of the transect. The shallow areas were mostly *S. purpuratus* barrens with occasional patches of *Macrocystis pyrifera*. *S. purpuratus* were very abundant, and in some areas they were estimated to cover 50% of the substrate. In January, whole *S. purpuratus* tests were common along

the transect, and sea urchin wasting syndrome was observed in the shallow areas, but was very patchy.

In January, we estimated that 25% of the *S. purpuratus* showed signs of wasting syndrome in the shallow area inshore of the transect. Many of these *S. purpuratus* appeared to be recovering, regrowing new spines. *S. franciscanus* were common with a density of 2.6/m<sup>2</sup>. Small *S. franciscanus* were common under the spine canopy of larger conspecifics. *Patiria miniata*, *Pisaster giganteus*, and *Pycnopodia helianthoides* were all common having densities of 1.3/m<sup>2</sup>, 0.3/m<sup>2</sup>, and 0.018/m<sup>2</sup> respectively. The sea star *Mediaster aequalis* was also common.

*Chromis punctipinnis* and *Oxyjulis californica* were common in the kelp canopy, and *Sebastes atrovirens* were common near the bottom. Juvenile, male and female *Semicossyphus pulcher* were observed. *Atherinops affinis* (top smelt) were abundant on the surface. A *Torpedo californica* (California electric ray) and a *Ophiodon elongatus* (lincod) were seen.

Eight of the ARMs were sampled for all indicator species and the remaining seven were sampled for all indicator species except sea urchins. Three *Haliotis rufescens* (10, 14, and 15 mm), and six *H. corrugata* (11, 22, 22, 23, 25, and 25 mm) were found. *Cypraea spadicea* were abundant, 261 were found. Small *Megathura crenulata* were relatively common; 12 were found and all were less than 40 mm. *Strongylocentrotus franciscanus* and *S. purpuratus* were abundant. In the eight ARMs, 402 and 440 were found respectively. Most of the *S. franciscanus* were small, less than 30 mm.

**Location: Fry's Harbor, Santa Cruz Island**

**Site #7 SCIFH**

1994 sampling dates: 1/20, 7/14, 7/15, 9/28

1994 status: open area

Overall this site has changed little in recent years. *Macrocystis pyrifera* continued to be absent at this site, and there was little other foliose algae. Adult and juvenile *Eisenia arborea* were more common on

the northern half of the line than last year, but overall *E. arborea* are relatively uncommon along the line with a density of  $0.1/\text{m}^2$ . Small numbers of *Laminaria farlowii* were present on the northern end of the line, but none were in the quadrat counts. Miscellaneous red and green algae were mostly filamentous and covered 19% and 1.1% of the bottom respectively. Several patches of brown algae (*Dictyota/Pachydictyon*) were present along the line. Crustose coralline algae was abundant covering 51% of the bottom. Cobble substrate covered 10% of the bottom. Most of this substrate is a mixture of cobble and *Mytilus californianus* shells.

*Balanus spp.* (barnacles) and *Spirobranchus spinosa* (Christmas tree worms) were the most common miscellaneous invertebrates on RPCs. This category covered 12% of the bottom. *Balanus spp.* covered almost the entire temperature logger housing. *Astrangia lajollaensis* were abundant covering 20% of the bottom. *Balanophyllia elegans* were common covering 0.6% of the bottom. Miscellaneous bryozoans (mostly *Thalamoporella californica*) were abundant covering 15% of the bottom. *Diaperoecia californica* was common and covered 5.1% of the bottom.

*Pachythyone rubra* was abundant, especially on the northern half of the transect. Overall, they covered 17% of the bottom, but there were patches of bottom that appeared to be completely covered. *Parastichopus parvimensis* were common with a density of  $0.88/\text{m}^2$ . *Lytechinus anamesus*, *Strongylocentrotus franciscanus*, and *S. purpuratus* densities were  $2.2/\text{m}^2$ ,  $1.4/\text{m}^2$ , and  $2.6/\text{m}^2$  respectively. The *S. franciscanus* were mostly present in crevices, while the *S. purpuratus* were present in crevices and among the cobble/mussel shell substrate. Two *S. purpuratus*, and several *L. anamesus* were observed with sea urchin wasting syndrome. Several *Centrostephanus coronatus* (Coronado sea urchins) were observed, but they were uncommon.

Fish were abundant and diverse at this site. Adult *Chromis punctipinnis* were abundant, and juvenile were common during our later visit in September. *Chromis punctipinnis* egg clusters were abundant in the ARMs as well as in crevices. *Caulolatilus princeps* (ocean whitefish), *Paralabrax clathratus*,

female and male *Semicossyphus pulcher* were abundant. *Sebastes atrovirens* and *S. serriceps* were common. *Coryphopterus nicholsii* were common having a density of  $0.65/\text{m}^2$ , and many small individuals were seen. One *Hypsypops rubicundus* was observed along the transect. *Cephaloscyllium ventriosum* were common.

The seven ARMs were sampled for all indicator species. *Spirobranchus spinosa*, and the snail, *Amphissa versicolor*, were abundant in all of the ARMs. Small hermit crabs were also abundant and used the *A. versicolor* shells. One small *Haliotis fulgens* (19 mm) was found. Small *Hinnites giganteus* were abundant; 105 were found with a mean size of 20 mm. *Patiria miniata* were common. *Strongylocentrotus franciscanus* and *S. purpuratus* were abundant, 554 and 742 were found in the ARMs respectively. Most were less than 15 mm, and their mean sizes were 12 and 13 mm respectively.

**Location: Pelican Bay, Santa Cruz Island**

**Site: #8 SCIPB**

1994 sampling dates: 1/20, 8/25, 8/26, 9/29

1994 status: kelp forest

This site has developed into a kelp forest over the past three years. *Macrocystis pyrifera* canopy over the transect was estimated at 20%. In January, canopy cover was estimated at 50%. Canopy cover is possibly limited by boat traffic in this popular anchorage. Large and small adult *M. pyrifera* were abundant having a density of  $0.43/\text{m}^2$ , and juvenile *M. pyrifera* had a density of  $0.15/\text{m}^2$ . *M. pyrifera* covered 13% of the bottom. This is a large decrease from its 1993 coverage of 70%, and is probably a result of the decrease in juvenile *M. pyrifera* densities. *Eisenia arborea* was common in the shallow area on the south side of the transect. Other brown algae covered 24% of the bottom, and consisted primarily of *Sargassum muticum* and *Pachydictyon/Dictyota* type algae. Most of the larger *S. muticum* was unhealthy, but healthy juveniles were present along the transect, and juveniles were

common in the shallow area south/inshore of the transect. In January, *Sargassum muticum* was abundant with plants up to 2 m high forming a dense understory along the entire transect.

The most common miscellaneous invertebrates on RPCs were the brittle star, *Ophiactis simplex*, and the worm, *Pista elongata*. This category covered 14% of the transect. Bryozoans covered 14% of the bottom. The most common bryozoan was *Thalamoporella californica*. *Balanus* spp. were abundant on the temperature logger housing in January.

*Patiria miniata* and *Pisaster giganteus* were uncommon. Their densities were  $0.075/\text{m}^2$  and  $0.025/\text{m}^2$  respectively. Sea star wasting disease was observed in *P. miniata*, *P. giganteus*, and *Astrometis sertulifera*. Five of the 15 *P. miniata* and *P. giganteus* measured for size frequencies had wasting syndrome. One *Lytechinus anamesus* was observed with sea urchin wasting syndrome. *Strongylocentrotus franciscanus* density was  $4.6/\text{m}^2$ . *S. purpuratus* was recorded at its highest density ( $26/\text{m}^2$ ) since monitoring began at this site. Small/juvenile *S. purpuratus* were abundant in the patches of *Thalamoporella californica*. *Parastichopus parvimensis* were common having a density of  $0.27/\text{m}^2$ .

*Astraea undosa* were common with a density of  $1.5/\text{m}^2$ . *Aplysia californica*, and California black sea hares, *Aplysia vaccaria*, were uncommon. The opisthobranch, *Navanax inermis* was observed.

Overall, fish were abundant at this site. *Coryphopterus nicholsii*, *Lythrypnus dalli*, *Alloclinus holderi*, *Rhacochilus toxotes* (rubberlip surfperch), *Embiotoca jacksoni*, *Damalichthys vacca*, *Myliobatis californica* (bat rays), female and juvenile *Semicossyphus pulcher*, adult and juvenile *Paralabrax clathratus* and *Oxyjulis californica* were all common. A dead *Squatina californica* (angel shark) was observed on the bottom. A school of *Phanerodon furcatus* (white surfperch) was observed in January.

The half inch stainless steel thread rod with the temperature logger attached to it was missing. The rod was broken off at the base, where the marine epoxy was flush with the rock substrate. A new thread rod and temperature logger was installed on top of a large boulder about 1.5 m west of the north end of the transect.

The seven ARMs at this site were sampled for the first time. *Thalamoporella californica* carpeted the tops of the ARMs. Two small (32 and 59 mm) *Haliotis corrugata* were found. Small *Hinnites giganteus* were abundant, 53 were found with a mean size of 16 mm. *Cypraea spadicea* were common. *Strongylocentrotus franciscanus* and *S. purpuratus* were abundant and small. The mean size for the 323 *S. franciscanus* was 21 mm, and the mean size for the 1,177 *S. purpuratus* was 11 mm. Very small *S. purpuratus* were abundant among the "carpet" of *T. californica* on the tops of the ARMs. The ARMs that were deployed at this site were constructed with cages that were held together on all sides by cable ties. Some of the cages were already falling apart, and all will eventually need replacing. Three of the cages were replaced this year.

**Location: Scorpion Anchorage, Santa Cruz Island**

**Site #9 SCISA**

1994 sampling dates: 1/20, 7/27, 8/10, 8/25

1994 status: purple sea urchin barrens

Most of the area surrounding the transect has changed little and continues to be dominated by *Strongylocentrotus purpuratus* and mostly devoid of macroalgae. However, the last 25 m on the west end of the transect had several small adult *Macrocystis pyrifera* plants growing near the transect and juveniles were common along the transect. Overall, *M. pyrifera* canopy cover was estimated at 5%. Juvenile *M. pyrifera* was present on quadrats for the first time since 1985, and its density was recorded at 1.3/m<sup>2</sup>. *M. pyrifera* coverage was recorded at 7.6%. Also present on this end of the



transect was the green algae, *Halicystis ovalis*, juvenile *Sargassum* sp., *Colpomenia* sp., and *Dictyota/Pachydictyon* type of brown algae. Miscellaneous brown algae covered 5.8% of the bottom. Encrusting coralline algae was abundant covering 58% of the bottom. Bare substrate covered 34% of the bottom. In January, *Sargassum muticum* was growing along the transect.

As of January, the area inshore, offshore, and west of the transect have transformed to a young kelp forest. These areas were previously *Strongylocentrotus purpuratus* barrens and now have canopy forming adult and juvenile *M. pyrifera*, understory foliose brown and red algae were abundant, and few *S. purpuratus*. *Sargassum muticum* was common growing with the *M. pyrifera*.

The most common miscellaneous invertebrates on RPCs were *Spirobranchus spinosus*, and the brittle stars, *Ophiothrix spiculata*. This category covered 14% of the bottom. Bryozoans were uncommon and only covered 0.4% of the bottom. *Serpulorbis squamigerus* were common covering 1.8% of the bottom.

*Strongylocentrotus purpuratus* dominated the site and had a density of 38/m<sup>2</sup>.

*S. purpuratus* were less abundant at the west end of the transect. Juvenile *S. purpuratus* were common along the eastern 70 m of the transect. *S. franciscanus* density was 0.6/m<sup>2</sup>. *Lytechinus anamesus* were common along the transect and had a density of 0.55/m<sup>2</sup> on quadrats, and 0.049/m<sup>2</sup> on band transects. Several *L. anamesus* were observed with wasting syndrome. *Pisaster giganteus* were rare and only one was seen near the transect. *Patiria miniata* and *Parastichopus parvimensis* were common. Their densities were 0.15/m<sup>2</sup> and 0.4/m<sup>2</sup> respectively.

*Megathura crenulata* were common with a density of 0.11/m<sup>2</sup> and some were observed spawning. *Astraea undosa* were abundant with a density of 1.3/m<sup>2</sup>. In January, the snail *Ceratostoma nuttali* and their eggs were common on rocks. *Flabellina iodinea* (spanish shawl nudibranch) were abundant and observed laying eggs.

Overall, fish appeared to be more abundant than in previous years. Adult and juvenile *Coryphopterus nicholsii* were common having a density of 0.75/m<sup>2</sup>. *Embiotoca jacksoni*, *Oxyjulis californicas*, *Chromis punctipinnis*, *Paralabrax clathratus* and *Sebastes serranoides* were all common. Adult and juvenile *S. serriceps* and *Heterostichus rostratus* (giant kelp fish) were observed. Several *Myliobatis californica*, a school of *Sardinops sagax* (Pacific sardines), *Paralabrax nebulifer* (barred sand bass) and a *Gymnothorax mordax* (California moray) were also seen.

All seven ARMs were sampled for index species. Three small *Haliotis corrugata* were found; their sizes were 9, 21, and 51 mm. *Hinnites giganteus* were common, 28 were found in the ARMs. About half of the *H. giganteus* were greater than 60 mm, the largest being 125 mm. *Cypraea spadicea* were common, 79 were found. Nine *Astraea undosa* were found in the ARMs, five of these were less than 20 mm. *Strongylocentrotus franciscanus* were common and most were small (65% were less than 15 mm) with a mean size of 19 mm. *S. purpuratus* were abundant, 772 were found in the ARMs. Of these, 39% were less than 15 mm, and the mean size was 26 mm.

**Location: Yellowbanks, Santa Cruz Island**

**Site #10 SCIYB**

1994 sampling dates: 1/21, 7/25, 7/26, 8/22

1994 status: mature kelp forest

Overall, this site displayed little change since last year. *Macrocystis pyrifera* canopy cover was estimated at 35%. In January canopy cover was estimated at 20%, and most of the plants appeared healthy. Adult and juvenile *M. pyrifera* densities were 0.6/m<sup>2</sup> and 1.9/m<sup>2</sup> respectively, and covered 17% of the bottom. The adult *M. pyrifera* consisted of both large and small plants. In August approximately half of the *M. pyrifera* plants appeared healthy, and half had discolored/tattered fronds.

Understory algae was abundant and consisted primarily of *Pterygophora californica*, *Cystoseira* spp. and *Laminaria farlowii*. These algae covered 33%, 22% and 17% of the bottom respectively. *P. californica* and *L. farlowii* densities were  $1.9/\text{m}^2$  and  $0.73/\text{m}^2$  respectively. Juvenile *P. californica* and *L. farlowii* were common. *Eisenia arborea* and miscellaneous red algae covered 6.9% and 9.0% of the bottom respectively. Articulated and crustose coralline algae covered 27% and 50% of the bottom respectively.

Miscellaneous invertebrates covered 14% of the bottom on RPC's. This category was dominated by the worm, *Pista elongata*, and hydroids. The hydroid, *Aglaophenia latirostris*, was common. Bryozoans covered 14% of the bottom and consisted mostly of *Diaperoecia californica*, *Bugula* sp., and *Thalamoporella californica*. *Lophogorgia chilensis*, *Muricea friticosa*, and *M. californica* had densities of  $0.026/\text{m}^2$ ,  $0.011/\text{m}^2$ , and  $0.019/\text{m}^2$  respectively. Tunicates covered 2.3% of the bottom and consisted mostly of *Aplidium* sp., and *Didemnum/Trididemnum*.

*Strongylocentrotus franciscanus* and *S. purpuratus* densities were  $0.4/\text{m}^2$ , and  $2.0/\text{m}^2$  respectively. Most of the sea urchins were confined to crevices, and many were too difficult to access for size frequency measurements. Small *S. purpuratus* were common under small rocks. *Parastichopus parvimensis* were common with density of  $0.43/\text{m}^2$ . *Patiria miniata*, *Pisaster giganteus*, and *Pycnopodia helianthoides* were relatively uncommon. Their densities were  $0.025/\text{m}^2$ ,  $0.025/\text{m}^2$ , and  $0.0014/\text{m}^2$  respectively.

*Astraea undosa* were common having a density of  $0.88/\text{m}^2$ . Only two *Haliotis corrugata* were counted on band transects ( $0.0028/\text{m}^2$ ). A juvenile (approximately 15mm) *H. corrugata* was found under a small rock. *Kelletia kelletii* were common having a density of  $0.0375/\text{m}^2$ . The opisthobranch, *Navanax inermis*, and their egg masses were common.

*Oxyjulis californica*, *Atherinops affinis* (top smelt), and small adult *Paralabrax clathratus* were

abundant in the upper part of the water column/kelp canopy. *Chromis punctipinnis*, *Sebastes atrovirens*, *Semicossyphus pulcher*, and *Halichoeres semicinctus* were all common.

The 15 ARMs closest to the line were sampled. Seven of these were sampled for all index species, and eight were sampled for all index species except for sea urchins. The five ARMs east of the east end of the transect were not sampled this year. Three of the five ARMs on the east end of the transect were missing their lids. Two of these lids were located and repaired, and the third was replaced. None of the bricks had been removed from the modules. The lids may have been removed by a diver, who with "good" intentions was trying to release any animals in the modules. In January, all 20 ARMs were intact.

In the ARMs, three small *Haliotis rufescens* were found, their sizes were 11,16, and 17 mm. Seven small *H. corrugata* were found, their sizes were 11,14,17,21,25,42, and 49 mm. *Cypraea spadicea* were present in all of the ARMs, 202 were found. Eleven small *Kelletia kelletii* with a mean size of 36 mm were present in the ARMs. The mean size for the 12 *Hinnites giganteus* found was 23 mm. *Patiria miniata* and *Pisaster giganteus* were common, 45 and 53 were found respectively. Seven *Lytechinus anamesus* were found and all were less than 16 mm. *Strongylocentrotus franciscanus* and *S. purpuratus* were abundant, in the seven ARMs sampled, 493 and 952 were found respectively.

**Location: Admiral's Reef, Anacapa Island**

**Site #11 ANIAR**

1994 sampling dates: 1/21, 8/8, 9/29, 9/30

1994 status: mature kelp forest

*Macrocystis pyrifera* canopy was estimated to cover 35% of the transect. Most of the *M. pyrifera* appeared unhealthy having discolored and tattered fronds. Epiphytic bryozoans and hydroids were common on the fronds. Adult and juvenile *M. pyrifera* densities were 0.23/m<sup>2</sup> and 1.2/m<sup>2</sup> respectively

and combined covered 12% of the bottom. Understory brown algae was abundant and consisted mostly of *Cystoseira* spp., *Eisenia arborea*, *Laminaria farlowii*, and *Agarum fimbriatum*. *Cystoseira* spp., *E. arborea* and *L. farlowii* covered 17%, 21%, and 6.8% of the bottom respectively. *E. arborea* and *L. farlowii* densities were 0.75/m<sup>2</sup> and 0.73/m<sup>2</sup> respectively. Miscellaneous red and brown algae (mostly *Dictyota/Pachydictyon* spp.) covered 30% and 29% of the bottom respectively. Overall, this site appeared to change little since last year.

Amphipod tube mats, gorgonians and hydroids were the most common miscellaneous invertebrates on RPCs. This category covered 23% of the bottom. *Lophogorgia chilensis*, *Muricea friticosa*, and *M. californica* were relatively abundant with densities of 0.11/m<sup>2</sup>, 0.014/m<sup>2</sup>, and 0.025/m<sup>2</sup> respectively. The purple gorgonian, *Eugorgia rubens*, was especially abundant at this site. *Spirobranchus spinosus* were common.

Small *Strongylocentrotus purpuratus* were abundant in the cobble area at the east end of the transect. Many of these urchins were estimated to be less than 20 mm. *S. franciscanus* were common in crevices, and *Centrostephanus coronatus* were also common. *S. purpuratus* and *S. franciscanus* densities were 12/m<sup>2</sup> and 5.8/m<sup>2</sup> respectively. *Lytechinus anamesus* were common, and were counted on both band transects and quadrats. Their densities were 0.097/m<sup>2</sup> and 1.1/m<sup>2</sup> respectively. *Patiria miniata* were common with a density of 0.53/m<sup>2</sup>. *Parastichopus parvimensis* were common with a density of 1.5/m<sup>2</sup>.

In January, *Lytechinus anamesus* were observed with wasting syndrome, and whole tests were common along the transect. *L. anamesus* were common in the cobble areas close to the transect, their density was 0.097/m<sup>2</sup>. In the shallow (<30ft.) areas inshore of the transect *S. purpuratus* barrens and patches of *Macrocystis pyrifera* were common. Some of the patches of *S. purpuratus* had no signs of wasting syndrome, while in other patches almost 100% of the *S. purpuratus* appeared to have the syndrome. Whole *S. purpuratus* tests were common, indicating recent mortality, though no *S.*

*purpuratus* with wasting syndrome were observed along the transect.

Three *Haliotis corrugata* were observed on band transects ( $0.0042/\text{m}^2$ ), and 23 were found for size frequency measurements. *Megathura crenulata* were common with a density of  $0.011/\text{m}^2$ . *Hinnites giganteus* were abundant over most of the reef, their density was recorded at  $0.24/\text{m}^2$ .

Overall, fish were abundant. *Chromis punctipinnis*, *Oxyjulis californica*, *Atherinops affinis* (top smelt), and *Girella nigricans* were abundant. Male and female *Semicossyphus pulcher*, adult and juvenile *Sebastes serriceps*, *S. chrysomelas* (black and yellow rockfish), and *Hypsypops rubicundus* were all common. A *Caulolatilus princeps* was seen.

All seven ARMs were sampled for index species. No *Haliotis sp.* were found this year. Mean size for the 36 *Hinnites giganteus* found in the ARMs was 16 mm. Most of the 64 *Patiria miniata* found were small. *Strongylocentrotus franciscanus* and *S. purpuratus* were abundant and small. The mean size for the 454 *S. franciscanus* found was 26 mm, and the mean size for 920 *S. purpuratus* was 19 mm.

**Location: Cathedral Cove, Anacapa Island**

**Site #12 ANICC**

1994 sampling dates: 1/21, 8/11

1994 status: kelp forest

*Macrocystis pyrifera* canopy cover over the transect was estimated at 80%. Both small and large adult *M. pyrifera* were common, adult density was  $0.35/\text{m}^2$ . Most of the adult *M. pyrifera* plants appeared healthy. Juvenile *M. pyrifera* was abundant with a density of  $4.8/\text{m}^2$ , but many of the juveniles were growing epiphytically on other algae. Overall, *M. pyrifera* was abundant and covered

28% of the bottom. Adult and juvenile *Laminaria farlowii* were abundant, but patchy. *L. farlowii* density was recorded at 1.7/m<sup>2</sup>. *Cystoseira* spp. was common covering 4.6% of the bottom. Miscellaneous red and brown algae were common covering 13% and 15% of the bottom respectively. Articulated and crustose coralline algae were common covering 21% and 37% of the bottom respectively. In January, the temperature logger housing was almost completely covered with encrusting coralline alga on its sides, and articulated coralline algae on the top.

*Spirobranchus spinosus* and spirorbids were the most common miscellaneous invertebrates on RPCs. This category covered 5.8% of the bottom. The spirorbids were often epiphytic on *Cystoseira* spp. The bryozoan *Thalamoporella californica* was abundant and represented most of the other bryozoan category on RPCs. Bryozoans combined, covered 23% of the bottom, their highest recorded coverage at this site.

*Patiria miniata* and *Pisaster giganteus* were uncommon along the transect. However, juvenile *P. miniata* were common under rocks. *Strongylocentrotus franciscanus* and *S. purpuratus* densities were 4.0/m<sup>2</sup> and 3.1/m<sup>2</sup> respectively. *Parastichopus parvimensis* were common having a density of 0.78/m<sup>2</sup>.

*Panulirus interruptus* were abundant with a density of 0.035/m<sup>2</sup>. *Hinnites giganteus* and *Astraea undosa* were abundant with a densities of 0.34/m<sup>2</sup> and 4.1/m<sup>2</sup> respectively. *Aplysia californica* were common, and the black sea hare, *A. vacaria*, were abundant. The latter was observed breeding.

Juvenile and adult *Chromis punctipinnis*, *Oxyjulis californica*, *Hypsypops rubicundus*, and *Sebastes serriceps* were common. Adult and juvenile *Alloclinus holderi* were abundant with a density of 1.1/m<sup>2</sup>.

Six of the seven ARMs were sampled for all indicator species and one ARM was sampled for all

indicator species except sea urchins. No *Haliotis* sp. were found in the ARMs this year. *Cypraea spadicea* were abundant. Mean size of the 44 *Hinnites giganteus* found was 17 mm. Small *Patiria miniata* and *Pisaster giganteus* were common. *Strongylocentrotus franciscanus* and *S. purpuratus* were abundant and small. The mean size for the 769 *S. franciscanus* found in the six ARMs was 18 mm, and the mean size for the 602 *S. purpuratus* found in the six ARMs was 20 mm.

**Location: Landing Cove, Anacapa Island**

**Site #13 ANILC**

1994 sampling dates: 1/18, 8/24, 9/30

1994 status: open kelp forest

Overall, this site appeared similar to previous years. This site is characterized by an open kelp forest with little canopy, due to boat traffic in the cove. However, there were thick patches of kelp canopy on the eastern and western ends of the transect. *Macrocystis pyrifera* covered 30% of the bottom. Adult and juvenile *M. pyrifera* densities were 0.5/m<sup>2</sup> and 2.1/m<sup>2</sup> respectively. Understory algae were abundant. *Eisenia arborea*, and the red algae, *Gelidium purpurascens*, were the most abundant understory algae on the shallow/eastern part of the transect. The most abundant understory algae along the rest of the transect were *Laminaria farlowii*, *E. arborea* and *Pterygophora californica*. Their densities were 12/m<sup>2</sup>, 1.4/m<sup>2</sup>, and 0.38/m<sup>2</sup> respectively. Adult and juvenile *L. farlowii* were abundant, and adult and juvenile *E. arborea* and *P. californica* were common. On quadrats, we decided to distinguish between large (approximately greater than 25 cm) and small (approximately less than 25 cm) for these three species of algae because of the large number of small plants present. Of the 498 *L. farlowii* plants counted on quadrats, 430 were small. Of the 57 *E. arborea* counted on quadrats, 27 were small, and of the 15 *P. californica* counted on quadrats, five were small. *Cystoseira* spp. and articulated coralline algae were common covering 9.2% and 26% of the bottom respectively. Miscellaneous red algae covered 17% of the bottom and consisted mostly of *G. purpurascens*.



Crustose coralline algae was abundant covering 51% of the bottom.

On RPC's, the most common miscellaneous invertebrates were *Spirobranchus spinosus* (Christmas-tree worms), and hydroids. This category covered 6.8% of the bottom. Bryozoans combined covered 14% of the bottom. Tunicates and sponges covered 3.4% and 1.8% of the bottom respectively.

*Patiria miniata* and *Pisaster giganteus* were uncommon along the transect and none were observed on quadrats this year. *Strongylocentrotus franciscanus* and *S. purpuratus* densities were  $3.1/\text{m}^2$  and  $1.7/\text{m}^2$  respectively. One *S. purpuratus* was observed with wasting syndrome in a ARM. *Parastichopus parvimensis* were common having a density of  $0.23/\text{m}^2$ .

*Hinnites giganteus* and *Astraea undosa* were abundant with a densities of  $0.34/\text{m}^2$  and  $1.3/\text{m}^2$  respectively. *Haliotis corrugata* were common with a density of  $0.025/\text{m}^2$ . A total of 10 relatively fresh *H. corrugata* shells were found in Landing cove this year. Eight of the shells were measured, their sizes were: 93, 137, 140, 146, 148, 159, 164, and 179 mm. Hand removal of abalone was attempted to test for strength, but all were strongly attached to their substrate. The opisthobranch, *Navanax inermis*, and their eggs were common.

Adult and juvenile *Chromis punctipinnis*, *Oxyjulis californica*, and *Hypsypops rubicundus* were common. Female *Semicossyphus pulcher*, *Girella nigricans*, *Embiotoca jacksoni* and large adult *Paralabrax clathratus* were common.

The seven ARMs were sampled for all index species. On October 4, the two ARMs that were in the middle of the cove were relocated to where the other five ARMs were located. Three small (18, 20, and 32 mm) *Haliotis corrugata* were found this year. *Cypraea spadicea* were common. Small *Hinnites giganteus* were abundant, 90 were found with a mean size of 15 mm. Small *Patiria miniata* were common, 48 were found with a mean size of 19 mm. *Strongylocentrotus franciscanus* and *S.*

*purpuratus* were abundant and small. The mean size for the 253 *S. franciscanus* found was 20 mm, and the mean size for the 614 *S. purpuratus* found was 21 mm.

**Location: Southeast Sea Lion, Santa Barbara Island**

**Site #14 SBISESL**

1994 sampling dates: 3/17, 6/20, 6/21, 6/24, 9/12

1994 status: mature kelp forest/purple sea urchin barren

*Macrocystis pyrifera* canopy cover over the transect was estimated at 65% in June, and 10% in September. Adult *M. pyrifera* density decreased to 0.3/m<sup>2</sup> from 0.63/m<sup>2</sup> in 1993. Overall adult *M. pyrifera* were larger than in 1993. The mean number of stipes/plant increased to 10 from 4 in 1993, and the mean holdfast width increased to 17 cm from 10 cm in 1993. No juvenile *M. pyrifera* was observed along the transect this year. *M. pyrifera* covered 6.0% of the substrate, a decrease from the 36% coverage in 1993. The *M. pyrifera* plants on the southern half of the line are larger/older than the plants on the northern half. Most of the *M. pyrifera* appeared healthy with few epiphytes growing on the blades. Many of the *M. pyrifera* holdfasts had high densities of *Strongylocentrotus purpuratus* in them, and it was common to see holdfasts infested with *S. purpuratus* that had no stipes attached. Patches of urchin barrens were present along the transect. *Cystoseira* spp. covered 9.0% of the bottom. Miscellaneous red, brown and green algal coverage decreased from 1993, their coverage this year was 1.5%, 1.0%, and 0.6% respectively. *Laminaria farlowii* covered 1.3% of the bottom. Overall, there was less foliose algae than in 1993. Crustose coralline algae was abundant covering 63% of the bottom, its highest recorded coverage at this site. Bare substrate coverage was relatively low (15%) for this site.

Miscellaneous invertebrates covered 16% of the bottom, and consisted mostly of amphipod tube mats and gorgonians. *Balanophyllia elegans* and *Astrangia lajollaensis* covered 1.3% and 2.2% of the

bottom respectively. Bryozoans and tunicates were common, covering 5.9% and 4.3% of the bottom. *Lophogorgia chilensis* and *Muricea californica* were common, while *M. fruticosa* were less common. Small *L. chilensis* were common along the transect. *Tethya aurantia* were abundant and had a density of  $0.12/\text{m}^2$ . Mysids were common on the bottom and in the kelp canopy.

*Aplysia californica* were less abundant than in 1993. This year's density was  $0.0056/\text{m}^2$ , compared to  $0.61/\text{m}^2$  in 1993. The opisthobranch, *Navanax inermis* and their eggs were common. Two *Haliotis corrugata* were found on band transects, and a 16 mm *H. corrugata* was found on the epoxy attached to the temperature recorder housing. *Astraea undosa* density was recorded at  $0.28/\text{m}^2$ . The coffee bean snail, *Trivia solandri*, was common.

*Strongylocentrotus franciscanus* and *S. purpuratus* were more abundant than last year. *S. franciscanus* density was  $7.2/\text{m}^2$  compared to  $2.7/\text{m}^2$  in 1993, and *S. purpuratus* density was  $65/\text{m}^2$  compared to  $17/\text{m}^2$  in 1993. Very small, less than 10 mm *S. purpuratus* were abundant on the encrusting coralline algae. These small urchins were covered with sand or debris and were not counted on quadrats because they were too difficult to see. The high density of small *Strongylocentrotus spp.* prompted us to use  $1 \text{ m}^2$  quadrats to collect *S. franciscanus* and *S. purpuratus* for size frequency measurements. In a one  $\text{m}^2$  quadrat, 237 *Strongylocentrotus spp.* were measured, most were less than 10 mm. *Lytechinus anamesus* were common with a density of  $2.4/\text{m}^2$  on band transects and  $5.9/\text{m}^2$  on quadrats. *L. anamesus* were observed with wasting syndrome. *Patiria miniata* and *Pisaster giganteus* were common.

Small juvenile and female *Semicossyphus pulcher* were abundant. Small *Coryphopterus nicholsii* (approximately 3 cm) were common, but few adults were observed. *Alloclinus holderi* were common. Small schools of juvenile *Oxyjulis californica*, and juvenile giant kelp fish, *Heterostichus rostratus*, were common in the kelp canopy. Kelp surfperch, *Brachyistius frenatus*, were abundant in the kelp canopy.

On June 24, the dive boat *Sand Dollar* from Long Beach was anchored off the south end of the transect. Another dive boat, the *Encore* was anchored 200 m south of the transect.

**Location: Arch Point, Santa Barbara Island**

**Site #15 SBIAP**

1994 sampling dates: 3/17, 6/20, 6/21, 9/13

1994 status: young kelp forest

Adult *Macrocystis pyrifera* plants were present along the entire transect. Kelp canopy cover was thick and covered 100% of the transect. In March, kelp canopy cover was estimated at 70%. Most of the *M. pyrifera* was healthy and had few epiphytes growing on the fronds. *M. pyrifera* covered 14% of the bottom. Adult and juvenile *M. pyrifera* plants were abundant having densities of 0.25/m<sup>2</sup> and 1.2/m<sup>2</sup> respectively. Juvenile *M. pyrifera* was often found growing epiphytically on other algae. Adult and juvenile *Eisenia arborea* were common having a density of 0.23/m<sup>2</sup>. *Cystoseira spp.* covered 1.1% of the bottom. *Cystoseira neglecta*, *C. setchellii*, and *Sargassum sp.* were present. *C. osmundacea* and *Halidrys dioica* were also present; these species are difficult to distinguish. Green algae decreased to 0.1% coverage from 9.4% in 1993. Miscellaneous brown algae coverage decreased to 8.6% from 23% in 1993. Miscellaneous red algae coverage decreased to 2.4% from 12% in 1993. Brown algal filaments (possibly diatom chains) were common, growing on rocks and on the articulated coralline algae. Articulated coralline algae was abundant covering 39% of the bottom, and crustose coralline algae covered 45% of the bottom. Overall, algae was less abundant than in 1993. Bare substrate covered 10% of the bottom.

Miscellaneous invertebrates covered 13% of the bottom, and consisted mostly of hydroids. Bryozoans were abundant covering 25% of the bottom, their highest recorded coverage at this site. The most

common species were *Bugula neritina* and *Thalamoporella californica*. Tunicates were common covering 4.5% of the bottom. *Muricea fruticosa* and *M. californica* were rare along the transect.

*Astraea undosa* were abundant, and most were small. Their density was  $1.7/\text{m}^2$ . The *A. undosa* found on the inshore (shallow) side were notably smaller than the ones found on the offshore (deeper) side of the transect. *Aplysia californica* were common, but less abundant than in 1993. Two small (approximately 20 mm) *Haliotis corrugata* were found. *Octopus sp.* were common along the transect.

*Patiria miniata* and *Pisaster giganteus* were rare. Neither species were found on quadrats this year. Only four *Patiria miniata* and 11 *Pisaster giganteus* were found during size frequency measurements. *Strongylocentrotus franciscanus* were recorded at their highest density ( $5.0/\text{m}^2$ ) at this site since monitoring began. *S. purpuratus* density increased to  $20/\text{m}^2$  from  $5.7/\text{m}^2$  in 1993, but are still below their 12 year average. No sea urchins were observed with wasting syndrome. Small (less than 10 mm) *S. purpuratus* were common on the crustose coralline algae covered cobble on the deeper side of the transect.

Overall, fish were abundant at this site. Halfmoon (*Medialuna californiensis*), *Girella nigricans*, *Oxyjulis californica*, *Alloclinus holderi*, and small *Paralabrax clathratus* were all common. Large male and female, small female, and juvenile *Semicossyphus pulcher* were common. Small schools of very small juvenile *Oxyjulis californica* were common in the kelp canopy. *Halichoeres semicinctus*, and adult and juvenile *Hypsypops rubicundus* were abundant. Several *Caulolatilus princeps* were observed.

**Location: Cat Canyon, Santa Barbara Island**

**Site #16 SBICC**

1994 sampling dates: 3/17, 6/23, 9/13

1994 status: young dense kelp forest

This site is continuing to undergo dramatic change. The *Macrocystis pyrifera* canopy was thick and covered 100% of the transect. Adult *M. pyrifera* were abundant along the entire transect ( $1.4/\text{m}^2$ ), but most plants were small. Juvenile *M. pyrifera* plants were uncommon, and none were found in quadrats this year. This is a marked difference from the abundant juveniles that were present in 1993. However, patches of juvenile kelp were present in areas of high light such as near sand patches. *M. pyrifera* covered 41% of the bottom. All of the *M. pyrifera* appeared very healthy. In March, canopy cover was estimated at 90% and no juvenile *M. pyrifera* were observed. Green, miscellaneous brown, and red algal coverage decreased from 1993. Green algae decreased to 0.0% from 4.1%, miscellaneous brown algae decreased to 0.1% from 19%, and miscellaneous red algae decreased to 0.5% from 15%. *Gelidium spp.* was present covering 0.8% of the bottom. Articulated and crustose coralline algae covered 15% and 34% of the bottom respectively. Bare substrate was recorded at its lowest coverage (8.2%) since 1987.

*Phragmatopoma californica* covered 5.1% of the bottom and were mostly found in the kelp holdfasts, but some were present on exposed rock. Bryozoans covered 9.2% of the bottom. Miscellaneous invertebrates covered 7.9% of the bottom and consisted primarily of hydroids. Tunicates were recorded at their highest coverage (21%) since monitoring began at this site in 1986. The most abundant tunicates were *Aplidium propinquum*, *A. arenatum*, and *Diplosoma macdonaldi*. *Didemnum carnulentum* and small aggregations (1-4 individuals) of *Clavelina huntsmani* (light-bulb tunicate), were also common. *Spirobranchus spinosus* were also common and sometimes completely covered boulders.

*Aplysia californica* were rare, and none were found on band transects. *Astraea undosa* were common having a density of  $0.53/\text{m}^2$ . *Tegula sp.* (turban snails), were abundant along the transect.

*Trivia californica* were common. Three *Haliotis corrugata* were found on band transects.

*Strongylocentrotus purpuratus* density remained low, 6.4/m<sup>2</sup>. *S. franciscanus* density was 4.4/m<sup>2</sup>. Juvenile *S. franciscanus* were abundant under the spine canopy of adult conspecifics. No sea urchins with wasting syndrome were observed. A sea urchin diver was observed fishing about 200 m south of the transect on June 22. *Pisaster giganteus* were common. *Patiria miniata* were rare, and none were observed on quadrats.

Small *Paralabrax clathratus*, *Hypsypops rubicundus*, and female *Semicossyphus pulcher* were common.

**Location: 100 m south of Wash Rock near the west end of Santa Barbara Island.**

1994 sampling dates: 3/18

site status: mature kelp forest

We conducted a survey dive at this location at depths between 50 - 70 ft.. This area is typical of a mature kelp forest, consisting of mostly large canopy forming *Macrocystis pyrifera* plants with a thick understory of algae. The understory was composed mostly of *Eisenia arborea*, articulated coralline, the red alga, *Plocamium* sp., and other miscellaneous red algae. Juvenile *M. pyrifera* was common. Most of the *M. pyrifera* was healthy, but some of the plants had fronds that were tattered and/or had epiphytic hydroids (*Obelia* sp.) on them.

*Strongylocentrotus franciscanus* were common, but there were few *S. purpuratus*.

*Centrostephanus coronatus* were abundant relative to our other sites on this island. *Pisaster giganteus* and *Henricia leviuscula* (blood stars) were common. The brittle star, *Ophiothrix*

*spiculata*, was abundant and carpeted the bottom in some areas.

There was little bare substrate, and most of the bottom was covered with encrusting tunicates, sponges and bryozoans. Small patches of the bryozoan, *Bugula sp.*, were abundant. Moon sponges, *Spheciospongia confoederata*, were also abundant. No *Allopore californica* was seen. *Hinnites giganteus* were uncommon, and only one *Haliotis corrugata* was seen. *Panulirus interruptus* were common.

Fish were abundant. The most common were *Chromis punctipinnis*, *Oxyjulis californica*, male and female *Semicossyphus pulcher*. *Embiotoca jacksoni*, and *E. lateralis* were common. *Sebastes atrovirens* and a pregnant *S. serripes* were observed.

#### **Location: East side of Shag Rock, Santa Barbara Island**

1994 sampling date: 6/23

A brief survey dive was made off the east side of Shag Rock. *Macrocystis pyrifera* canopy cover around Shag Rock was 100%. The canopy was very thick and appeared healthy. This area was characteristic of a mature kelp forest, consisting of large, mature canopy forming *M. pyrifera* plants. Juvenile *M. pyrifera* were present in small patches. *Eisenia arborea* was abundant in the shallow areas (less than 7 m). Articulated coralline algae was abundant. Most of the bottom was covered with a thick layer of encrusting invertebrates, consisting of mostly tunicates, sponges, bryozoans, and hydroids. Adult *Strongylocentrotus franciscanus* were abundant, and juveniles were abundant in the spine canopy of conspecifics.

#### **GENERAL DISCUSSION**



In 1994, kelp (*Macrocystis pyrifera*) forests were present at 13 of the 16 sites. These included all sites at Santa Barbara, Anacapa, and Santa Rosa Islands, as well as Yellow Banks, Gull Island, and Pelican Bay at Santa Cruz Island, and Wyckoff Ledge at San Miguel Island. Scorpion Anchorage on Santa Cruz Island, remains barren with little algae, and high densities of *Strongylocentrotus purpuratus*. Hare Rock on San Miguel Island continues to be sea urchin barrens, dominated by *S. franciscanus*. Fry's Harbor on Santa Cruz Island had some understory brown algae, but continued to be dominated by *Pachythyone rubra*.

The three Santa Barbara island sites that transformed from sea urchin barrens to kelp forest in 1993, continued to have relatively high densities of *Macrocystis pyrifera*. However, all three sites experienced a reduction in foliose algae compared to 1993. Cat Canyon and Arch Point continued to progress towards mature kelp forests. Southeast Sealion appears to be returning to sea urchin barrens. At Southeast Sealion, *Strongylocentrotus purpuratus* and *S. franciscanus* recruitment was high, and densities increased to almost four and three times their densities recorded in 1993, respectively. *Strongylocentrotus spp.* were actively feeding on *M. pyrifera*, and we expect this site to rapidly return to sea urchin barrens if this scenario continues.

Although the Scorpion Anchorage transect has changed little since 1985, the areas surrounding the transect have changed dramatically during the past year. Last year the entire area was considered *Strongylocentrotus purpuratus* barrens identical to the transect. By January, areas inshore, offshore, and west of the transect had transformed into a young kelp forest. The abundance of *S. purpuratus* densities decreased in these areas. In 1992, several *S. purpuratus*, and *Lytechinus anamesus* were observed with sea urchin wasting syndrome along the transect (Richards and Kushner, 1994), but no sea urchin wasting syndrome was observed in 1993 (Kushner et. al., 1995), and only several *L. anamesus* with wasting syndrome were observed this year. These areas exhibited no evidence (presence of sea urchin spines and/or tests) of *S. purpuratus* mass mortality. This evidence suggests it

is unlikely that sea urchin wasting syndrome caused the decline of *S. purpuratus* at this location.

The sea urchin wasting syndrome that was first observed during kelp forest monitoring in 1992 (Richards and Kushner, 1994) continues to be a common sight on Santa Cruz, Anacapa, and Santa Barbara Islands. Sea urchin wasting syndrome was observed in *Strongylocentrotus purpuratus* and *Lytechinus anamesus* this year. The prevalence of sea urchin wasting syndrome on or near the Kelp Forest Monitoring sites has remained relatively constant. The syndrome was observed at seven locations in 1993 and 1994 (Table 6), and six locations in 1992. The location and species affected has varied from year to year. Overall, sea urchin tests were relatively uncommon along the transects, indicating no mass mortalities. However, *S. purpuratus* tests were common inshore of the Admiral's Reef transect where large numbers of *S. purpuratus* were observed with wasting syndrome. *S. purpuratus* tests were also common along the transect at Gull Island in January. Large numbers of *S. purpuratus* were observed with wasting syndrome inshore of this transect. It is likely that tests moved downward towards the transect due to the steep topography at this location.

Sea star wasting disease was observed afflicting three species at one site in 1994 (Table 6). This disease, in which the infected animals appear to be decaying, is possibly caused by a bacterial infection (Schroeter and Dixon, 1988). Observations of this disease have gradually decreased since 1992. The disease was observed at eight sites during 1992, and three during 1993.

In 1994, 10 of the 16 Kelp Forest Monitoring sites had artificial recruitment modules (ARMs), and all were monitored. ARMs were monitored for the first time at Pelican Bay, Santa Cruz Island. At two sites, several of the tops of the ARMs had been removed. It is likely that other divers found the ARMs and removed the tops with the good intention of releasing trapped animals. Although the ARMs look like traps, animals that enter them can also get out, unless they grow too large. Broken bricks were replaced in most of the ARMs, and several cages were replaced. The brass number tags which have been used to distinguish the ARM's are rapidly corroding and falling off. If it is necessary to continue to

distinguish between the ARMs, new stainless steel tags should be used. Overall, the ARMs were in good condition, and needed little repair.

Overall, recruitment of both *Strongylocentrotus purpuratus* and *S. franciscanus* in the ARMs increased from 1993. In the nine stations with ARMs that have been monitored for more than one year, *S. franciscanus* recruitment (number of sea urchins less than 15 mm) increased at five, decreased at two, and remained about the same at two stations. *S. purpuratus* recruitment (number of sea urchins less than 15 mm) also increased at five, decreased at two, and remained about the same at two stations. It is interesting to note that the sites that increased, decreased, and remained about the same were the same stations for both species.

*Haliotis corrugata* recruitment in the ARMs was about the same as in 1993. Comparing only the six stations where ARMs have been monitored since 1992, 12 *H. corrugata* less than 26 mm were found in 1994, compared to 11 in 1993 and three in 1992. *Haliotis rufescens* recruitment was higher at these six stations than in 1992 and 1993. Eight *H. rufescens* less than 26 mm were found in 1994, compared to three in 1993, and two in 1992. Abalone less than 26 mm were used for this comparison, because they are probably less than 1.5 years old (Hahn, 1989), and only have been detectable in the modules for about one year. California Department of Fish and Game Biologists reported good recruitment of *H. rufescens* at Castle Rock, San Miguel Island (pers. communication).

No withering syndrome was observed during kelp forest monitoring this year. However, *Haliotis rufescens* with withering syndrome were reported from San Miguel and Santa Rosa Islands.

According to NOAA's El Niño Advisories (NOAA, 1994), the waters around the Channel Islands were 1.0 - 3.0 °C above average from January - July, 1994. During our January cruise, pelagic red crabs (*Pleuroncodes planipes*) were observed at Talcott Shoal, Santa Rosa Island. In 1994, this was our only sighting of a species often associated with El Niño conditions. The July issue of the El Niño

advisory stated that there has been a gradual return to near normal temperature conditions since the 1992 - 1993 El Niño.

Overall, the temperature loggers are working well. However, we are still trying to work out problems with battery disconnection or failure. Because our sampling is conducted from June through September we decided to present 12 months of temperature data from June 1, 1993 to May 31, 1994 for this annual report. Since the data collected from June - December, 1993 was included in the 1993 report (Kushner et al, 1995), it will not be discussed here.

In January 1994, we retrieved and redeployed the 13 temperature loggers at Anacapa, Santa Cruz, Santa Rosa, and San Miguel Islands. The temperature loggers on Santa Barbara Island were retrieved and redeployed on March 17. The temperature loggers were also retrieved and deployed at all sites during the regular summer sampling. We experienced difficulties with the batteries at both San Miguel Island sites. At these sites the recorders were working until the middle of February and then stopped. At Pelican Bay Santa Cruz Island, the temperature logger and thread rod on which it was attached was missing. Hence, no data was collected. At the remaining 13 sites, temperature data were collected since the loggers deployments in either January or March.

A new version of the HOBOTEMP<sup>tm</sup> temperature loggers called STOWAWAY's<sup>tm</sup> were deployed this summer. These new loggers have increased memory allowing us to sample for a full year. To ensure continuous data sets through the year, both a HOBOTEMP<sup>tm</sup> and a STOWAWAY<sup>tm</sup> temperature logger were deployed at each site. With two loggers per site, it is unlikely that we will experience data loss unless the units are missing or the housing floods.

Although sightings of Blue, *Balaenoptera musculus*, and Humpback whales, *Megaptera novaeangliae*, were not made during monitoring cruises this year, sightings were reported around the islands throughout the summer. Sightings of Rizzo's Dolphins, *Grampus griseus*, were also common.

In January, a sea otter, *Enhydra lutris*, with a blue tag was observed on the west side of Castle Rock, San Miguel Island. Records of marine mammal sightings during the kelp forest monitoring cruises are kept on record; 16 recordings were made this year. A beached whale was surveyed at Green Canyon, Santa Rosa Island. Although the whale was partially buried and decomposed we believe it was a Blue whale

Although all monitoring was completed at the permanent sites, little time was available to conduct survey dives in other areas. Bad weather and boat problems hindered our activities. Sampling the ARMs at 10 locations required more time than was anticipated. Approximately 45 minutes of underwater time are required to sample each ARM, and there are currently 97 ARMs.

This year project divers assisted San Diego State University with sea urchin recruitment and growth studies on Anacapa Island, and the California Department of Fish and Game with sea urchin and abalone population studies in Fort Bragg, California. This summer the Kelp Forest Monitoring Program was photographed at Anacapa Island, Landing Cove while working on the transect by a NAUI film crew. NAUI is working on a educational film for training divers. *Astraea undosa* data was sent to Andrea Alfaro, a graduate student at California State University, Northridge, temperature data was sent to Onset Instruments, and all Kelp Forest Monitoring data was sent to Dan Reed at the Marine Science Institute, University of California at Santa Barbara.

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Table 1. Regularly monitored species by taxonomic grouping, common name, scientific name and associated monitoring technique.

TAXA/COMMON NAME	SCIENTIFIC NAME	TECHNIQUE
ALGAE		
Miscellaneous Green Algae		
Miscellaneous Red Algae		
Articulated Coralline Algae		R
Crustose Coralline Algae		R
Agar weed	<i>Gelidium spp.</i>	R
Sea tongue	<i>Gigartina spp.</i>	R
Miscellaneous Brown Algae		R
Acid weed	<i>Desmarestia spp.</i>	R
Oar weed	<i>Laminaria farlowii</i>	R,Q
Bladder chain kelp	<i>Cystoseira spp.</i>	R
Giant kelp	<i>Macrocystis pyrifera</i>	R,Q
California sea palm	<i>Pterygophora californica</i>	R,Q
Southern sea palm	<i>Eisenia arborea</i>	R,Q
Miscellaneous plants		R
INVERTEBRATES		
Miscellaneous Sponges		R
Orange puffball sponge	<i>Tethya aurantia</i>	B,S
Southern staghorn bryozoan	<i>Diaperoecia californica</i>	R
Miscellaneous Bryozoans		R
California hydrocoral	<i>Allopora californica</i>	B,S
White-spotted rose anemone	<i>Tealia lofotensis</i>	B
Red gorgonian	<i>Lophogorgia chilensis</i>	B,S
Brown gorgonian	<i>Muricea fruticosa</i>	B,S
California golden gorgonian	<i>Muricea californica</i>	B,S
Strawberry anemone	<i>Corynactis californica</i>	R
Orange cup coral	<i>Balanophyllia elegans</i>	R
La Jolla cup coral	<i>Astrangia lajollaensis</i>	R
Hydroids		R
Ornate tube worm	<i>Diopatra ornata</i>	R
Colonial sand-tube worm	<i>Phragmatopoma californica</i>	R
Scaled-tube snail	<i>Serpulorbis squamigerus</i>	R
Chestnut cowrie	<i>Cypraea spadicea</i>	Q
Wavy turban snail	<i>Astraea undosa</i>	Q,S
Red turban snail	<i>Astraea gibberosa</i>	Q,S
Bat star	<i>Patiria miniata</i>	Q,S
Giant-spined sea star	<i>Pisaster giganteus</i>	Q,S
Sunflower star	<i>Pycnopodia helianthoides</i>	B,S
White sea urchin	<i>Lytechinus anamesus</i>	B,S
Red sea urchin	<i>Strongylocentrotus franciscanus</i>	Q,S
Purple sea urchin	<i>Strongylocentrotus purpuratus</i>	Q,S
Warty sea cucumber	<i>Parastichopus parvimensis</i>	Q
Aggregated red sea cucumber	<i>Pachythyone rubra</i>	R
Red abalone	<i>Haliotis rufescens</i>	B,S
Pink abalone	<i>Haliotis corrugata</i>	B,S
Green abalone	<i>Haliotis fulgens</i>	B,S

Table 1. continued.

TAXA/COMMON NAME	SCIENTIFIC NAME	TECHNIQUE
Kellett's whelk	<i>Kelletia kelletii</i>	B,S
Giant keyhole limpet	<i>Megathura crenulata</i>	B,S
California brown sea hare	<i>Aplysia californica</i>	B
Scaled tube snail	<i>Serpulorbis squamigerus</i>	R
Rock scallop	<i>Hinnites giganteus</i>	B,S
California spiny lobster	<i>Panulirus interruptus</i>	B
Tunicates		R
Stalked tunicate	<i>Styela montereyensis</i>	Q
Miscellaneous Invertebrates		R
SUBSTRATE		
Bare Substrate		R
Substrates: Rock		R
Cobble		R
Sand		R
FISH		
Bluebanded goby	<i>Lythrypnus dalli</i>	Q
Blackeye goby	<i>Coryphopterus nicholsii</i>	Q
Island kelpfish	<i>Alloclinus holderi</i>	Q
Blacksmith	<i>Chromis punctipinnis</i>	V
Señorita	<i>Oxyjulis californica</i>	V
Blue rockfish	<i>Sebastes mystinus</i>	V
Olive rockfish	<i>Sebastes serranoides</i>	V
Kelp rockfish	<i>Sebastes atrovirens</i>	V
Kelp bass	<i>Paralabrax clathratus</i>	V
Sheephead	<i>Semicossyphus pulcher</i>	V
Black surfperch	<i>Embiotoca jacksoni</i>	V
Striped surfperch	<i>Embiotoca lateralis</i>	V
Pile perch	<i>Damalichthys vacca</i>	V
Garibaldi	<i>Hypsypops rubicundus</i>	V
Opaleye	<i>Girella nigricans</i>	V
Rock Wrasse	<i>Halichoeres semicinctus</i>	V

B= Band Transect  
 Q= Quadrat Count  
 R= Random Point Contact  
 S= Size Frequency Measurement  
 V= Visual Transect

#### CHANGES IN SCIENTIFIC NOMENCLATURE:

*Patiria miniata* = *Asterina miniata*  
*Astraea undosa* = *Lithopoma undosum*  
*Astraea gibberosa* = *Lithopoma gibberosum*  
*Hinnites giganteus* = *Crassedoma giganteum*

Table 2. Station information.

SITE NUMBER	ISLAND	LOCATION	ABBREVIATION	DEPTH (METERS)	YEAR EST.
1	San Miguel	Wyckoff Ledge	SMIWL	13-15	1981
2	San Miguel	Hare Rock	SMIHR	6-9	1981
3	Santa Rosa	Johnson's Lee North	SRIJLNO	9-11	1981
4	Santa Rosa	Johnson's Lee South	SRIJLSO	14-16	1981
5	Santa Rosa	Rodes Reef	SRIRR	13-15	1983
6	Santa Cruz	Gull Island South	SCIGISO	14-16	1981
7	Santa Cruz	Fry's Harbor	SCIFH	12-13	1981
8	Santa Cruz	Pelican Bay	SCIPB	6-8	1981
9	Santa Cruz	Scorpion Anchorage	SCISA	5-6	1981
10	Santa Cruz	Yellowbanks	SCIYB	14-15	1986
11	Anacapa	Admiral's Reef	ANIAR	13-15	1981
12	Anacapa	Cathedral Cove	ANICC	6-11	1981
13	Anacapa	Landing Cove	ANILC	5-12	1981
14	Santa Barbara	SE Sea Lion Rookery	SBISESL	12-14	1981
15	Santa Barbara	Arch Point	SBIAP	7-8	1981
16	Santa Barbara	Cat Canyon	SBICC	7-9	1986

Table 3. Summary of sampling techniques used to monitor population dynamics of selected kelp forest organisms.

#### TECHNIQUE

Quadrat count

Band Transect count

Random Point Contact

Visual Fish transects

Video transects

Size frequency measurements

Species checklist

Artificial Recruitment Modules

Table 4. Kelp forest monitoring site status 1994.

San Miguel Island

Wyckoff Ledge                      Mature kelp forest with dense canopy  
and abundant understory red algae.

Hare Rock                              Sea urchin barren, high density of  
*Strongylocentrotus franciscanus*.

Santa Rosa Island

Johnson's Lee North              Mature kelp forest with a high density  
of *Macrocystis pyrifera*.

Johnson's Lee South              Mature kelp forest with a dense canopy.

Rodes Reef                              Open mature sparse kelp forest with a  
low density of *Macrocystis pyrifera* and                      abundant  
understory of red algae.

Santa Cruz Island

Gull Island South                      Mature kelp forest with a low abundance  
of understory algae.

Fry's Harbor                              Open area with an abundance of  
*Pachythyone rubra* and *Astrangia lajollaensis*.

Pelican Bay                              Kelp forest.

Scorpion Anchorage              Sea urchin barren with high density of  
*Strongylocentrotus purpuratus*, and low  
diversity.

Yellowbanks                              Mature kelp forest with a abundant  
understory of brown algae.

Anacapa Island

Admiral's Reef                              Mature kelp forest with a moderate  
understory of brown algae and a diverse  
assemblage of fish and invertebrates.

Cathedral Cove                              Mature kelp forest with a dense canopy,  
high density of *Macrocystis pyrifera*,  
and moderate abundance of understory algae.

Landing Cove                              Open kelp forest with a diverse  
assemblage of fish and invertebrates.

Santa Barbara Island

SE Sea Lion Rookery              Mature kelp forest/sea urchin barren.  
Distinct patches of kelp forest and sea                      urchins.

Arch Point

Young kelp forest.

Cat Canyon

Young dense kelp forest.

Table 5. 1994 kelp forest monitoring program participant and cruise list.

<u>PARTICIPANTS</u>	<u>AFFILIATION</u>	<u>CRUISES</u>
<u>PARTICIPATED</u>		
Arnold Ammann 3,4,5,6,7,8,9	Channel Islands National Par	
Doug Albin	Calif. Dept. of Fish and Game	8
Bill Avery	Utah State University	3
Katie Beauchamp	Hopkins Marine Station	4
John Brooks	National Park Service (SCRU)	9
Don Canestro	Univ. Calif. Santa Cruz	9
John Conti	Channel Islands NPS (VIP)	6,8
Gary Davis	National Biological Survey	7
Dennis Divins	Univ. Calif. Santa Barbara	7
Mike Donnellan	Univ. Calif. Santa Barbara	7
Keith Duran	Channel Islands National Park	4,5,7
Ginny Eckert	Univ. Calif. Santa Barbara	8
Henery C. Fastenau	Univ. Calif. Davis	9
Veronica Franklin	Univ. Calif. Santa Cruz	7
Tim Glass	Channel Islands National Park	3
Peter Haaker	Calif. Dept. of Fish and Game	7
Scott Harris	Calif. Dept. of Fish and Game	5
Ladd Johnson	Univ. Calif. Santa Barbara	8
David Kushner 1,2,3,4,5,6,7,8,9	Channel Islands National Park	
Derek Lerma 3,4,5,6,7,8,9	Channel Islands National Park	
Mark Linder	Channel Islands National Park	5
David Matras	Channel Islands NPS (VIP)	4
Ari Martinez	Univ. Calif. Santa Barbara	1
Carolyn Meyer	Redwood National Park	3
John Miller	NOAA/Channel Islands NMS	6
Kenneth Miller	Univ. Calif. Santa Barbara	5
Heather Parker	National Marine Fishery Service	5
Julie Pearson	Channel Islands NPS (VIP)	3,4,5,6
John Provo	Channel Islands National Park	8,9
Karen Press	Moss Landing Marine Lab	1,6
Dan Richards	Channel Islands National Park	1,4,9
Diane Richardson	Channel Islands National Park	1,3,7,8,9
Laura Rogers-Bennet	Univ. Calif. Davis	9
Dave Score	NOAA/Channel Islands NMS	1
Mack Shaver	Channel Islands National Park	3
Dave Steichen	Univ. Calif. Santa Barbara	8
Ian Taniguchi	Calif. Dept. of Fish and Game	6
Ronald Walder	Channel Islands National Park	3,4,5,6,7
Dwight Willey	Channel Islands National Park	2,6
Jill Zamzow	Univ. Calif. Santa Cruz	5

Cruise Dates 1994

Cruise #1	January 18-21, 1994
Cruise #2	March 17-18, 1994
Cruise #3	June 20-24, 1994
Cruise #4	July 11-15, 1994

Cruise #5	July 25-29, 1994
Cruise #6	August 8-12, 1994
Cruise #7	August 22-26, 1994
Cruise #8	September 12-16, 1994
Cruise #9	September 26-30, 1994



Table 6. 1994 echinoderm wasting disease/syndrome observations.

<u>wasting syndrome</u>		Sea Star	<u>wasting disease</u>		Sea Urchin
		species			
<u>observed</u>	<u>dates</u>		<u>observed</u>	<u>species</u>	<u>dates</u>
<u>San Miguel Island</u>					
Wyckoff Ledge		none		none	
Hare Rock		none		none	
<u>Santa Rosa Island</u>					
Johnson's Lee North		none		none	
Johnson's Lee South		none		none	
Rodes Reef		none		none	
<u>Santa Cruz Island</u>					
Gull Island South		none		2*	
1/18,9/28					
Fry's Harbor		none		2,3	
7/14,9/28					
Pelican Bay		1,4,5	8/25	3	8/26
Scorpion Anchorage		none		3	8/10
Yellowbanks		none		none	
<u>Anacapa Island</u>					
Admiral's Reef		none		2,3*	
1/21,9/29					
Cathedral Cove		none		none	
Landing Cove		none		2	8/24
<u>Santa Barbara Island</u>					
SE Sea Lion Rookery		none		3	9/12
Arch Point		none		none	
Cat Canyon		none		none	

Species legend:

- 1 = *Patiria miniata*
- 2 = *Strongylocentrotus purpuratus*
- 3 = *Lytechinus anamesus*
- 4 = *Pisaster giganteus*
- 5 = *Astrometis sertulifera*

none = not observed at the site during our visits.  
date = dates disease/syndrome was observed.

\* = found inshore of the transect.

**Appendix B.** 1994 Species List for all Channel Islands National Park Kelp Forest Monitoring Stations.

Introduction

The species list contains presence/absence and relative abundance data for all species that could be found during the site visits between June and October. Generally at least one dive is made by an experienced biologist strictly for species list observations. The overall effort varies from station to station with the water conditions and available time. Relative abundance values are subjective, and generally based on opinions of several divers viewing the overall site. Some species assemblages are more difficult to identify than others and may be lumped into general categories. Organisms were generally not collected for additional taxonomic work. When identification is tentative we either do not mark it or place a question mark on the list. Some categories, (eg. sponges or tunicates) may be much more diverse than it would appear from the list.

Abundance Ratings:

- X - present, no relative abundance rating given
- 4 - abundant, organism present in higher than normal densities
- 3 - common, organism found over most of site or in high density patches
- 2 - present, organism found in moderate numbers
- 1 - rare, few organisms found
- 0 - noticeably absent, an effort was made to look for an organism that was not found

Notes:

- e - eggs
- j or jvs - juvenile
- s - shell only
- int - intertidal
- d - drift
- PM or night - seen only on night dive
- JX - juveniles present and adults present
- J#/# - (e.g. J3/2 - juvenile abundance 3, adult abundance 2)
- nests - *Hypsypop* nest turf
- dis - diseased

Station names are listed in Table 2 of the text.

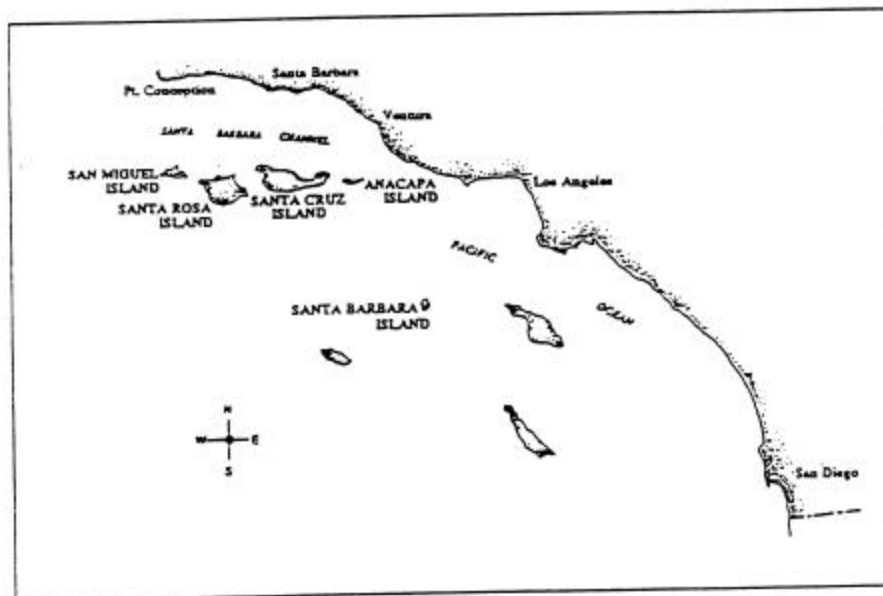
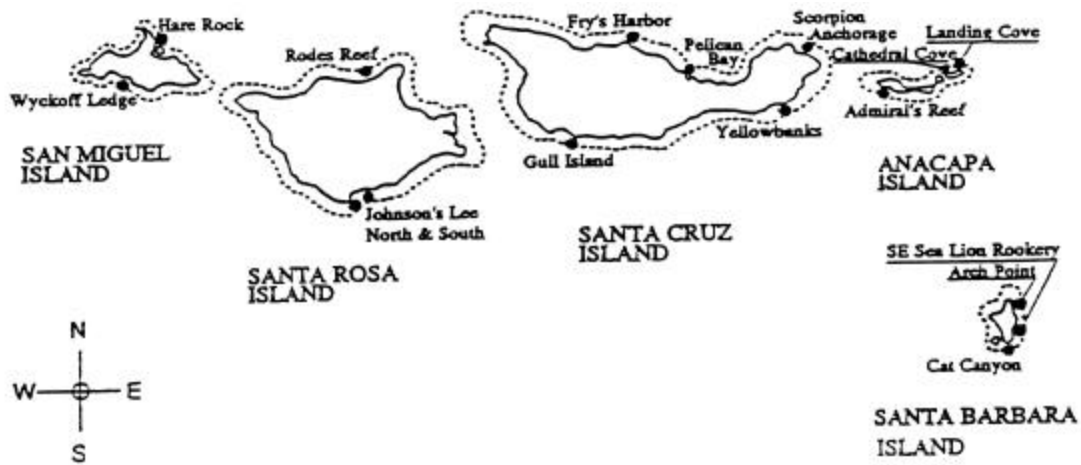


Figure 1. Kelp Forest Monitoring Locations (•) in Channel Islands National Park. Insert shows location of the five park islands in the Southern California Bight.

## 1994 Kelp Forest Monitoring Species List

Location:	SMIWL	SMIHR	SRIJLN	SRIJLS	SRIRR	SCIGIS	SCIFH	SCIPB	SCISA	SCIYB	ANJAR	ANICC	ANILC	SBISESL	SBIAP	SBICC
#:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SPECIES																
CHLOROPHYTA																
BRYOPSIS CORTICULANS	X															
CLADOPHORA GRAMINEA											2					
CODIUM CUNEATUM						2	2				2					
CODIUM FRAGILE		X			X									2		X
CODIUM HUBBSII/SETCHELLII			X								3					
CODIUM SETCHELLII	X	X		2		2								X		
DERBESIA MARINA	X				X	2	1				2		2			
ENTEROMORPHA SP.													X			
HALICYSTIS OVALIS						2					2					X
ULVA LACTUCA	X															
ULVA SP.		X														
PHAEOPHYTA																
AGARUM FIMBRIATUM											3		1			
COILODESME SP.						X										
COLPOMENIA PEREGRINA											X				X	X
COLPOMENIA SP.		X					1	3	X		X		X			
CYSTOSEIRA OSMUNDACEA	3			3	2	2					4		3			
CYSTOSEIRA SETCHELLII															X	
CYSTOSEIRA SP.			3											3	3	X
DESMARESTIA LIGULATA	j/2	X			1											
DESMARESTIA LIGULATA VAR. FIRMA	2															
DESMARESTIA MUNDA	X															
DICTYONEUROPSIS RETICULATA	2															
DICTYOPTERIS NEW SP.													2			
DICTYOPTERIS UNDULATA											3		3			
DICTYOTA BINGHAMIAE						2										
DICTYOTA FLABELLATA				2				3			3		3			
DICTYOTA/PACHYDICTYON					2						X			2	X	X
ECTOCARPOID FUZZ		X												X	X	
EGREGIA MENZIESII	d															d
EISENIA ARBOREA	2J/1	X		2	1	X	2	X			3		3		3	1
HALIDRYIS DIOICA		X					X									
LAMINARIA FARLOWII				2	2		1				3		4	2		X
LAMINARIA SETCHELLII		2														
LAMINARIA SP.	2				X											
MACROCYSTIS PYRIFERA	j3/4	j0/1	j4/4	j/4	j2/2	j2/3		X	2		j3/4		3	j1/2	j/3	j3/4
PTERYGOPHORA CALIFORNICA	2	X	3	X							3		2			
SARGASSUM MUTICUM								4	3				2			
SARGASSUM SP.														X	X	
ZONARIA FARLOWII						X		X					X			
RHODOPHYTA																
ACROSORIUM UNCINATUM					4						4					
AHNFELTIA PLICATA													2			
BOSSIELLA SP.		X	X	2		X									X	X
BOSSIELLA/CALLIARTHRON					1											
BOTRYOCLADIA PSEUDODICHOTOMA	2	X			2	1	1				1					
BOTRYOGLOSSUM FARLOWIANUM	3															
CALLIARTHRON CHEILOSPORIOIDES	3	X		3	2	3	2		X		3		3			
CALLIARTHRON SP.															X	X

## 1994 Kelp Forest Monitoring Species List

[illegible]

## 1994 Kelp Forest Monitoring Species List

Location: #:	SMIWL	SMIHR	SRIJLN	SRIJLS	SRIRR	SCIGIS	SCIFH	SCIPB	SCISA	SCIYB	ANJAR	ANICC	ANILC	SBISESL	SBIAP	SBICC
SCIADOPHYCUS STELLATUS						X					2		2			
SCINAIA SP.													X			
TIFFANIELLA SNYDERIAE						X								1		
FILAMENTOUS REDS																
HYPSYPOPS TURF NEST			X													
NON - FILA. REDS microscopic											3		3			
ANGIOSPERMA																
PHYLLOSPADIX SPP.					d										X	X
DIATOMS																
DIATOM FILM		3														
SCHIZYMENIA COLONIAL DIATOMS														2		
PROTOZOA																
HOMOTREMA RUBRUM						X					X					
GROMIA OVIFORMIS					X		X									
PORIFERA																
CLATHRINA BLANCA						1	X				1		X			
LEUCANDRA HEALTHI																X
LEUCETTA LOSANGELENSIS		3									X		X			
LEUCILLA NUTTINGI	X			1	X	2										X
LEUCOSOLENIA ELEANOR	3			1	1	2							X			3
SCYPHA CILIATA						X										
YELLOW SPONGE W/TALL PORES	2		3		X						X					
ACARNUS ERITHACUS	X			2	X											
ACARNUS SP.			X													
APLYSILLA GLACIALIS			X													
AXOCIELITA ORIGINALIS					X											
CLIONA CELATA	X			X	2	2	X		1		X		X			
HALICLONA					X	X										
HYMENAMPHIASTRA CYANOCRYPTA	X	X	X	3	X	2					2		3	X		
LISSODENDORYX TOPSENTI					X	X					X					
OPHALITASPONGIA PENNATA					X	X								X	X	X
PENARES CORTIUS				2		2					3		2			
POLYMASTIA PACHYMASTIA	X		3		X											
RED SPONGES - ENCRUSTING	X			2	2		X				3		2			
SPHECIOSPONGIA CONFOEDERATA			X								X					
TETHYA AURANTIA	3	2	2	3	2	2	2				X		X	3		
TETILLA ARB					3											
TETILLA FLAMINGO											X					
TETILLA SP.					2						2					
VERONGIA AUREA				2		2					2					
APLYSINA FISTULARIS											3		X			
XESTOSPONGIA TRINDINAEA	X	X	X	2	1	1					X					
CNIDARIA																
HYDROZOA																X
ABIETINARIA SP.	2			3		X					2					
AGLAOPHENIA SP.	2	X	4	3	2											
ALLOPORA CALIFORNICA						3										
ANTENELLA AVALONIA											2					
APOLEMIA SIPHONOPHORE						X										
CORYMORPHA SP.						X										
GARVEIA ANNULATA	3					2										

## 1994 Kelp Forest Monitoring Species List

Location: #:	SMIWL	SMIHR	SRIJLN	SRIJLS	SRIRR	SCIGIS	SCIFH	SCIPB	SCISA	SCIYB	ANIAR	ANICC	ANILC	SBISESL	SBIAP	SBICC
HYDRACTINIA SP.	X					X	2				2				2	
OBELIA SP.	4				2	2					3					
PLUMULARIA SP.	3	3	X	X	X	3/e	1				3		X			
SERTULARELLA SP.	X			2		X					X					
PACHYCERIANTHUS FIMBRIATUS	X	2		2	2	X	2		3		2		X			
CLAVULARIA SP.							3				2		X			
ANTHOZOA																
EUGORGIA RUBENS							1				4					
LOPHOGORGIA CHILENSIS	1		X	3	1	2	4				4		1	3	X	
MURICEA CALIFORNICA											4		1	3	X	
MURICEA FRUTICOSA						1					4			X		
EPIZOANTHUS SP.															X	
PARAZOANTHUS LUCIFICUM											X					
CORYNACTIS CALIFORNICA	3	3	X	2	3	3	2				2		2		2	X
ANTHOPLEURA ARTEMISIA					X											
ANTHOPLEURA ELEGANTISSIMA	X	X		X	2	2	2		3		X		X			
ANTHOPLEURA XANTHOGRAMMICA		X	X													
EPIACTIS PROLIFERA	3	X	X	X	3	1							X			
HALCAMP A DECEMENTENTACULATA	X	X	X								X					
METRIDIUM EXILIS	X															
METRIDIUM SENILE		X														
PHYLACTIS SP.															X	X
TEALIA COLUMBIANA	X			X	3											
TEALIA CORIACEA	X		X		2	X	X									
TEALIA LOFOTENSIS	3	X	X	2	2	2	X				X					
TEALIA SP.											X					
ZAOLUTUS ACTIUS	2			2	2	2			X							
ORDER MADREPORARIA																
ASTRANGIA LAJOLLENSIS	X	3		X	3	3	3				3		3	2	X	2
BALANOPHYLLIA ELEGANS	2	4	X	4	3	3	3				2		2	3	X	1
COENOCYATHUS BOWERSI											2		X			
PARACYATHUS STEARNSI	X	2	X	X	X	2	2				2		2		X	X
PLATYHELMINTHES	X	X				X									X	3
PROSTHECERAEUS BELLOSTRIATUS					X	X		X								
PSEUDOCEROS PERVIOLACEUS						X										
NEMERTEA						X										
CEREBRATULUS SP.		X				X										
TUBULANUS SEXLINEATUS	X			X												
TUBULANUS SP.	X															
SIPUNCULA	X		X	X		X										
THEMISTE PYROIDES	X															
POLYCHAETA																
ARCTONOE VITTATA						X										
BISPIRA TURNERI						X										
CHAEOPTERUS VARIOPEDATUS		X			4	X	X				X			X	X	X
DIOPATRA ORNATA	3		X	3	2	4	2				1					1
DODECACERIA FEWKESI	2	4			X	1					1			X	X	X
EUDISTYLIA POLYMORPHA	2	3		1	1											
FLABELLIGERA COMMENSALIS						X	X									
MESOCHAETOPTERUS SP.		X			X	X	X							X		
MYXICOLA INFUNDIBULUM	X	X			2	1	3									

Location: #:	SMIWL	SMIHR	SRIJLN	SRIJS	SIIRR	SCIGIS	SCIFH	SCIPB	SCISA	SCIYB	ANUAR	ANICC	ANILC	SBISESL	SBIAP	SBICC
OPHIODROMUS PUGETTENSIS	X	X	3	2	3	X	X				X					
PHRAGMATOPOMA CALIFORNICA	3		3	X	X										X	3
PHYLLODOCID							X									
PISTA ELONGATA	3		X	2	3	3					X		X			
SABELLID	X	X		X	X	X					X					
SALMACINA TRIBRANCHIATA	X	X	X	X	X	2	3				X					
SERPULA VERMICULARIS	X	X				2	X									
SPIROBRANCHUS SPINOSUS	X	4	X	X	X	4	3		3		3			2	3	3
SPIORBID	3		X	X	X	X					2			X	X	X
TEREBELLID		4			X	X	2									
THELEPUS CRISPUS					2											
POLYCHAETE "BALLOONS"	X															
ARTHROPODA																
CRUSTACEA																
CIRRIPEIDIA/THORACIA																
BALANUS AQUILA/NUBILUS		X			2	S										
BALANUS PACIFICUS	X															
BALANUS SPP.	X	4	X	X	2	2	3	3	4	X	X		X	X	X	X
CONOPEA GALEATA	X			3		2					3					
MEGABALANUS CALIFORNICUS	X	X	X	X	X	X					X		4		X	
TETRACLITA ELEGANS	X			X												
MYSIDS	3	4	2		3									0		
MYSIDS (brown canopy dwellers)	2				X											
MYSIDS (clear bottom dwellers)	3															
IISOFOIDA																
CIROLANA SP.	X															
IDOTEA RESECATA	3	X		X	4	X								2		
AMPHIPODA																
AMPHIPOD TUBE MASSES	X	X	X		X	X					X			2		
PERAMPITHOE SP.	X				2	X					2					
CAPRELLID	X					X	X									
GAMMARID	X				X	X	X							X	X	X
COPEPODS ON MEGATHURA CREMULATA			X													
COPEPODS ON FISH	X				3	X										
DECAPODA																
ALPEUS SP.			X	X	X	X	X									
BETAES MACGINITIEAE	X	X	X	X	X	X	X				X			X		X
CRANGON SP.	X															
HEPTACARPUS SPP.\ HIPPOLYTE SPP.	X														X	
LYSMATA CALIFORNICA					X	X	2				2		X		X	
PANDALUS DANAE	3	3	2	2	X	3	2				2		X			
SPIRINTOCARIS PRIONATA							X									
PANULIRUS INTERRUPTUS					1	2	1		X		X	3	2		X	X
BLEPHARIPODA OCCIDENTALIS				s												
CRYPTOLITHODES SITCHEMENSIS	X				X											
HAPALOGASTER CAVICAUDA	X		X	X	X											
PAGURISTES SPP.	X			X		X	X									
PAGURUS SPP.					3	X									X	X
PETROLISTHES SPP.	X		X	X	X		X									
PYLOPAGURUS SP.					X											
CANCER ANTENNARIUS	2		s	X												



Location: #:	SMIWL	SMIHR	SRIJLN	SRIJLS	SRIRR	SCIGIS	SCIFH	SCIPB	SCISA	SCIYB	ANIAR	ANICC	ANILC	SBISESL	SBIAP	SBICC
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CANCER SPP.	3				j		X				j					
HERBSTIA PARVIFRONS	X	X	X	X	X	X	X/e				X		X	X	X	
LOPHOPANOPEUS SPP.					X										X	
LOXORHYNCHUS CRISPATUS	X			X	2							X				
MIMULUS FOLIATUS	X															
PARAXANTHIAS TAYLORI						X	3/e				X				3	
PELIA TUMIDA					X											
PINNIXA SPP.					X											
PODOCHELA HEMPHILLI	X															
PUGETTIA PRODUCTA	3				2											
PUGETTIA RICHII	X	X														
PYROMAIA TUBERCOLATA						2					X					
SCYRA ACUTIFRONS	X	X									X					
<b>MOLLUSCA</b>																
<b>GASTROPODA</b>																
ACANTHINA SP.															X	X
ACMAEA MITRA	2	3														
AMPHISSA VERSICOLOR	2				X		4				4					X
ASTRAEA GIBBEROSA	3	1	X		X											
ASTRAEA UNDOSA			X		X	2	2	X	4	2	2	3	3	X	j4/3	j2/3
CALLIOSTOMA ANNULATUM	3	X														
CALLIOSTOMA CANALICULATUM	X															
CALLIOSTOMA LIGATUM	X				X		X									
CALLIOSTOMA SUPRAGRANOSUM					X											
CALLIOSTOMA GLORIOSUM											2					
CALLIOSTOMA SP.						X	X									
CERATOSTOMA FOLIATUM	2/e	2		2												
CERATOSTOMA NUTTALLI						2	2	4/e	4/e		2		X			
COLLISELLA SP.					X											
CONUS CALIFORNICUS	3	X			X	s			X		X		X	2	3	X
CREPIDULA ADUNCA	X															
CREPIDULA DORSATA	2	2			X	4	2				2					
CREPIDULA SP.			s	X	X											
CYPRAEA SPADICEA	X	3	3	2	2	2	3	X	X		2	X	X	X	X	X
DIODORA ARNOLDI					s											
DIODORA ASPERA		X														
DIODORA SP.											X					
EPITONIUM SP.	2				s						X					
ERATO VITELLINA	X										s					
ERATO SP.						s										
FISSURELLA VOLCANO							3INT									
FUSINUS KOBELTI		2	2													
FUSINUS LUTEOPICTUS					X	X	X				X					
HALIOTIS CORRUGATA						1	S				2		3	S		1
HALIOTIS CRACHERODII		2					j int							S		
HALIOTIS FULGENS							X							S		
HALIOTIS RUFESCENS	2	S	2	2	j/1	1										
HIPPONIX TUMENS	s				s											
HOMALOPOMA LURIDUM	X	X			X	X	X				X					
HOMALOPOMA SP.			X		X											
KELLETIA KELLETII	j/4	X	X	X	j/2	3	2				X		X			1

## 1994 Kelp Forest Monitoring Species List

Location: #:	SMIWL	SMIHR	SRIJLN	SRIJLS	SRIRR	SCIGIS	SCIFH	SCIPB	SCISA	SCIYB	ANIAM	ANICC	ANILC	SBISESL	SBIAP	SBICC
LATIAxis OLDROYDI							X				X					
MAXWELLIA GEMMA	S	X				X	X							X		
MAXWELLIA SANTAROSANA	X				X	2					X					
MEGATHURA CREMULATA	2		2	2	2	2	2	X	3		2		X	2	X	X
MITRA IDAE	X	X			X	2	X		X		X					
MITRELLA SP.	X				X											
NORRISIA NORRISI	X		X	2	X	4					2			2	X	X
OLIVELLA BIPPLICATA	X															
PEDICULARIA CALIFORNICA						2										
PETALOCNCHUS MONTEREYENSIS							X									
POLINICES SP.							e									
PSEUDOMELATOMA TOROSA	X															
PSEUDOMELATOMA SP.	X				X											
PTEROPURPURA TRIALATA	X	X														
SERPULORBIS SQUAMIGERUS	2	2	2	2	X	2	2		3		2		X		X	2
SIMNIA VIDLERI						2	2				4			X		
TEGULA AUREOTINCTA														X		
TEGULA EISENI				2		X	2		X				2	2	3	4
TEGULA REGINA						2	X				X			2		
TRIVIA CALIFORNIANA	X										X			2		
TRIVIA SOLANDRI						X									S	
VOLVARINA TAENIOLATA	X				2	X	X				X				X	
APLYSIA CALIFORNICA	X	j/2	X		2/E	2/E	2		X		2		X	2	X	j2/x
APLYSIA VACCARIA						3/E					X				X	
BERTHELLINA ENGELI							X								2	
NAVANAX INERMIS	2	3	X	3	X/E	X	3				X			X		X
HAMINOEA SP.							S								X	
RICTAXIS PUNCTOCALATUS	X															
TYLODINA FUNGINA											X					
NUDIBRANCHIA																
ANISODORIS NOBILIS	X	X		3	X	X										
ARCHIDORIS MONTEREYENSIS	X				X	X										
CADLINA LIMBAUGHII					X		X									
CADLINA LUTEOMARGINATA	X			2		X	X						X			
CADLINA SP.	X															
CHROMODORIS MACFARLANDI						X	X						X			
CHROMODORIS PORTERAE						X	X									
CORYPHELLA SP.											X					
DENDRODORIS SPP.					X											
DENDRONOTUS ALBUS/DIVERSICOLOR				X	X											
DENDRONOTUS SPP.	X															
DIALULULA SANDIEGENSIS	X	X	X		X	X	X				X					
DORIOPSILLA ALBOPUNCTATA	X	X		X	X	X	X									
FLABELLINOPSIS IODINEA	X	X			X	X	X				X				X	X
CORYPHELLA IODINEA	X					2	X	X	3/e		X					
HERMISSENDA CRASSICORNIS	X	X			X	3	X									
JORUNNA PARDUS						X										
LAILA COCKERELLI					X	X	X				X					
MEXICHROMIS PORTERAE											X					
PELTODORIS N.SP.						X										
PHIDIANA PUGNAX / HILTONI	X			X	X										X	

Location: #:	SMIWL 1	SMIHR 2	SRIJLN 3	SRIJLS 4	SRIRR 5	SCIGIS 6	SCIFH 7	SCIPB 8	SCISA 9	SCIYB 10	ANIAR 11	ANICC 12	ANILC 13	SBISESL 14	SBIAP 15	SBICOC 16
POLYCERA ATRA						X	X									
ROSTANGA PULCHRA					X											
TRIOPHA CATALINAE		X			X	X	X									
TRIOPHA MACULATA	X					X									X	
POLYPLACOPHORA	X				X	X										
LEPIDOZONA SP.					X											
NUTTALINA CALIFORNICA		X														
TONICELLA LINEATA	X															
BIVALVIA																
AMERICARDIA BIANGULATA								s						X		
CHACEIA OVOIDEA	X					X										
CHAMA ARCANA	X				X	X	2				2		X		X	
CHLAMYDOCONCHA ORCUTTI											2					
DIPLODONTA SP.						s					s		s			
GARI CALIFORNICA	s	s		s	s	s	s	s			s		X			
HIATELLA ARTICA				X		3										
HINNITES GIGANTEUS	3	X	X	2	2	2	3	X	X	X	3	3	4	X	2	1
IRUSELLA LAMELLIFERA	s	s				s					s					
LIMA HEMPHILLI	X	s	s	X	s	s	3		s		s				s	
MODIOLUS CAPAX		s														
MYTILUS CALIFORNIANUS		s					4int						int			
PARAPHOLUS CALIFORNICUS	X			2												
PECTEN DIEGENSIS								s								
PHOLAD	X	X	X		X		X									
PODODESMUS CEPIO	2	X	3	3	X	2	X	X	X		4					
SAXIDOMUS NUTTALLI										s						
SEMELE DECISA								s								
SEMELE RUPICOLA		s					s									
TIVELA STULTORUM																
TRACHYCARDIUM QUADRAGENARIUM					X	s		s						3	s	
TRESUS NUTTALLII					X											
VENTRICOLARIA FORDII	s	s		s	X	X					X					
CEPHALAPODA																
OCTOPUS BIMACULATUS/BIMACULOIDES		X		X	X	X					2		X			X
OCTOPUS SP.	X						3							2	X	
ECTOPROCTA																
AETEA SP.					X	X	3				X		X			
ANTROPORA TINCTA	X			X	X	3	2									
BUGULA CALIFORNICA	X			X		2	2				2			2	X	X
BUGULA NERITINA		X	X			2	3	X			2					
BUGULA SP.			X													
COSTAZIA ROBERTSONIAE	3			X	X	X	1									
CRISIA SP.	2				X	X										
DIAPEROECIA CALIFORNICA	X	X	X	X	X	2	3		1		3		X	1	X	X
EURYSTOMELLA SP.	X			X	X	X					X					
HIPPODIPLOSIA INSCULPTA	2		X	3	X	2	X						X			
LICHENOPORA NOVAE-ZELANDIAE						3					3		X	X	X	X
MEMBRANIPORA MEMBRANACEA	2			X		2					2					
MEMBRANIPORA TUBERCOLATA						X	X				X					
MEMBRANIPORA SP.	X		X	X	X		X							X	X	X
PARASMITTINA/RHYNCHOZOOON						X										

Location: #:	SMIWL	SMIHR	SRIJLN	SRIJLS	SRIRR	SCIGIS	SCIFH	SCPFB	SCISA	SCIYB	ANIAR	ANICC	ANILC	SBISESL	SBIAP	SBICC
PHIDOLOPORA LABIATA	X		3	4	5	6	7			10	11	12	13	14	15	16
PHIDOLOPORA PACIFICA	2		X	3	X	3	2				X					
THALAMOPORELLA CALIFORNICA				1	X	2	3								X	X
PHORONIDA																
PHORONIS VANCOUVERENSIS		X														
PHORONOPSIS CALIFORNICA								3								
ECINODERMATA																
ASTEOIDEA																
ASTROPECTEN ARMATUS	X							X			X					
DERMASTERIAS IMBRICATA	1		X	X	2	1										
HENRICIA LEVIUSCULA	2					3	X				4			X		
HENRICIA SP.	2	X	X	X	X		X				2					
LINCZIA COLUMBIAER											2					
LUIDIA FOLIOLATA	X															
MEDIASTER AEQUALIS				X	X	3										
ORTHASTERIAS KOEHLERI	2				X	1	2									
ASTERINA MINIATA	4	4	X	4	4	3	2		3		2			2	j2	j2/0
PISASTER BREVISPINUS		X		X	X		X									
PISASTER GIGANTEUS	2	4	X	2	2	2	2		X		2		X	2	X	X
PISASTER OCHRACEUS		X					X									
PYCNOPODIA HELIANTHOIDES	X	2	2	2	2	3	X									
ECHINOIDEA																
CENTROSTEPHANUS CORONATUS							2				3		X	1		1
LYTECHINUS ANAMESUS					S	1	4		1		3			2	X	X
STRONGYLOCENTROTUS FRANCISCANUS	2	4	2	2	3	3	2	X	X	2	3	3	3	3	2	3
STRONGLYOCENTROTUS FRANCISCANUS JUV.	2	1	X	X	X	3	2				2		X	3		4
STRONGYLOCENTROTUS PURPURATUS	1	2	2	2	2	4	2	2	4	2	3	2	2	4	2	2
STRONGLYOCENTROTUS PURPURATUS JUV.		1	X	X	X	3	2	4			3		X	4	2	2
OPHIUROIDEA																
OPHIACTIS SIMPLEX							3		X		3			X		
OPHIODERMA PANAMENSE	X		X	X	X	X	X				X		X		X	
OPHIOPLOCUS ESMARKI	X	X			2	X	2				X		X			
OPHIOPSILA CALIFORNICA					2											
OPHIOPTERIS PAPILLOSA	X		X	X	2	X	2		X		X		X			
OPHIOTHRIX SPICULATA		X	X	X	2	X	3				X			X	X	
HOLOTHUROIDEA																
CUCUMARIA PIPERATA	X	X		2	2	X										
CUCUMARIA SP.			X	X	X		X								X	
CUCUMARIA SALMA		X				X	2		3		X					
EUPENTACTA QUINQUESEMITA					2	X	2				X					
LEPTOSYNAPTA ALBICANS						X										
PACHYTHYONE RUBRA						2	4									
PARASTICHOPUS CALIFICORNICUS	X					1										
PARASTICHOPUS PARVIMENSIS	X	3	X	X	2	2	3	X	X		2	X	X	3	X	X
CHORDATA																
UROCHRDATA (TUNICATA)																
APLIDIUM SP.	X					X									3	4
ARCHIDISTOMA DIAPHANES					X											
ARCHIDISTOMA PSAMMION					X											
ARCHIDISTOMA SP.		X			X	X										
BOLTENIA VILLOSA	X		X	X	3		1									

Location: #:	SMIWL	SMIHR	SRIJLN	SRIJLS	SRIRR	SCIGIS	SCIFH	SCIPB	SCISA	SCIYB	ANIAR	ANICC	ANILC	SBISESL	SBIAP	SBICC
BOTRYLLOIDES DIEGENSIS					X											
BOTRYLLUS SP.						X										
CIONA INTESTINALIS		X				X										
CLAVELINA HUNTSMANI							X									X
CNEMIDOCARPA FINMARKIENSIS	X		X	X	3										X	X
CYSTODYTES LOBATUS / LOBED TUNICATE	3		2	3	3	2	X									
DIDEMNID spp.	2		X	X	X	2	X								X	X
EUHERDMANIA CLAVIFORMIS						X										
HALOCYNTHIA HILGENDORFI IGABOJA			X	X												
METANDROCARPA DURA				X												
METANDROCARPA TAYLORI							X				X		X			
POLYCLINUM PLANUM	X															
PYCNOCLOVELLA STANLEYI	X				X									2		X
PYURA HAUSTOR		X														
STYELA MONTEREYENSIS	2		3	3	3											
STYELA PLICATA	X					2					X					
TRIDIDEMNUM OPACUM			4	X	X											
VERTEBRATA																
CHONDRICTHYES																
CEPHALOSCYLLIUM VENTRIOSUM	X			2		e	X				e					
HETERODONTUS FRANCISCI	X					X			X				X		3	X
MYLIOBATIS CALIFORNICA							X		X					2		X
SQUATINA CALIFORNICA				X												X
TORPEDO CALIFORNICA			X	X												
GYMNOTHORAX MORDAX							X		X		X				X	
GOBIESOX SP.			X	X											X	
RIMICOLA MUSCARUM					X											
ATHERINOPS AFFINIS			4	4		X									X	X
ATHERINIDS											X					
CYPSELURUS CALIFORNICUS							X									
AULORHYNCHUS FLAVIDUS	2	2			X											
RATHBUNELLA HYPOPLECTA					X		X									
ALLOCLINUS HOLDERI					X	2	2		2		2		X	X	3	3
GIBBONSIA SP.	3	X			X						2		X			X
HETEROSTICHUS ROSTRATUS				X		j/X			1		2		3	X	4	X
NEOCLINUS STEPHANSAE	X				1	1	X		X							
COTTIDAE		X				X	X							X		
ARTEDIUS SP.				X												
ARTEDIUS CORALLINUS	X			X	X	X	X									
ARTEDIUS CREASERI							X				X					
LEIOCOTTUS HIRUNDO	j/X															
ORTHONOPIAS TRIACIS	X	X	X	X	X	2	X							X	X	
BRACHYSTIUS FRENATUS	X		X	X		2					X		X	3	3	X
RHACOCILUS VACCA	2	2	j2/2	2	j/X	2	2		X		X		X			
EMBIOTOCA JACKSONI	j2/2	2	2	2	2	2	1		2	2	2		X		X	X
EMBIOTOCA LATERALIS	2	2	X	3	2	1										
HYP SURUS CARYI	3				2											
PHANERODON FURCATUS									2							
RHACOCILUS TOXOTES			X	X	2		2		X	X	X		X			
CORYPHOPTERUS NICHOLSI	X	3	X	X	X	3	4	X	X		2		X	3	X	X
LYTHRYPNUS DALLI							2	3	2		X		X			

## 1994 Kelp Forest Monitoring Species List

Location:	SMIWL	SMIHR	SRIJLN	SRIJLS	SRIRR	SCIGIS	SCIFH	SCIPB	SCISA	SCIYB	ANIAR	ANICC	ANILC	SBISESL	SBIAP	SBICC
#:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
LYTHRYPNUS ZEBRA			X				2				X				X	
OPHIODON ELONGATUS	X	X		X	X		X									
OXYLEBIUS PICTUS	3	2	2	2	3	2	3	2	X		2		3	X		X
GIRELLA NIGRICANS				2		2	2	2	X		3		3	2	3	X
MEDIALUNA CALIFORNIENSIS			X		X	2	2	2			4		2	X	3	X
HALICHOERES SEMICINCTUS							X		X		X		X		3	2
H. SEMICINCTUS (FEMALES)							2		X		2		2		X	X
H. SEMICINCTUS (MALES)							2		X		2		2		X	X
H. SEMICINCTUS (JUVENILES)														X		
OXYJULIS CALIFORNICA	X	X	X	X	2	X	2	2	X		3		2	2	X	X
O. CALIFORNICA (JUVENILES)	X		X						X					2	3	X
SEMICOSSYPHUS PULCHER	2			3	3	3	2	2	2		2					
S. PULCHER (FEMALES)	X	X	X	X	3	2	3	X	X		3		2	4	3	3
S. PULCHER (MALES)	X			X	4	1	2	X			2		2	0	X	2
S. PULCHER (JUVENILES)						1	X		X				X	X		
CAULOLATILUS PRINCEPS					X		4				1		1			
CHROMIS PUNCTIPINNIS		2	X	X	2	2	4	4	X		4		3	2	3	2
C. PUNCTIPINNIS JUVENILES				X	1	2	2		X		3		3		3	
HYPSYPOPS RUBICUNDUS			X			1	2/e	X	X		4		3	2	4	4
H. RUBICUNDUS JUVENILES													X	X	4	2
SCORPAENA GUTTATA						1	X				2		X			
SEBASTES ATROVIRENS	3	2	2	2	3	3	2	X	X		2		X	X		2
S. ATROVIRENS (JUVENILES)	X	X			X	2										
SEBASTES CARNATUS	3	X		2	2	2	1		2		1					
SEBASTES CAURINUS	3	X	X	X	X	X										
SEBASTES CHRYSOMELAS	2	X	X	X	X	2	X	X	2		2					
SEBASTES MINIATUS	X				1											
SEBASTES MYSTINUS	2	3	X	2	3	X										
SEBASTES RASTRELLIGER						X										
SEBASTES SERRANOIDES	2	X	X	X	2	2	2				1		2			
S. SERRAN./S. FLAVIDUS (JUVENILES)					X									X		
SEBASTES SERRICEPS	2	X	X	X	1	2	2		X		3		3			
S. SERRICEPS (JUVENILES)											X		2			
SEBASTES SP. (JUVS.)	X						X									
PARALABRAX CLATHRATUS			X	2	2	2	4	4	3		2		3	2	3	3
P. CLATHRATUS (JUVENILES)									X					X		
PARALABRAX NEBULIFER									X							
SPHYRAENA ARGENTEA											X					
CITHARICHTHYS SP.	X															
PARALICHTHYS CALIFORNICUS	X															
PLEURONICHTHYS COENOSUS	X						X						X	X		
MAMMALIA																
PHOCA VITULINA					X	X	X				X					
ZALOPHUS CALIFORNIANUS	X				X	X	X							2	X	3

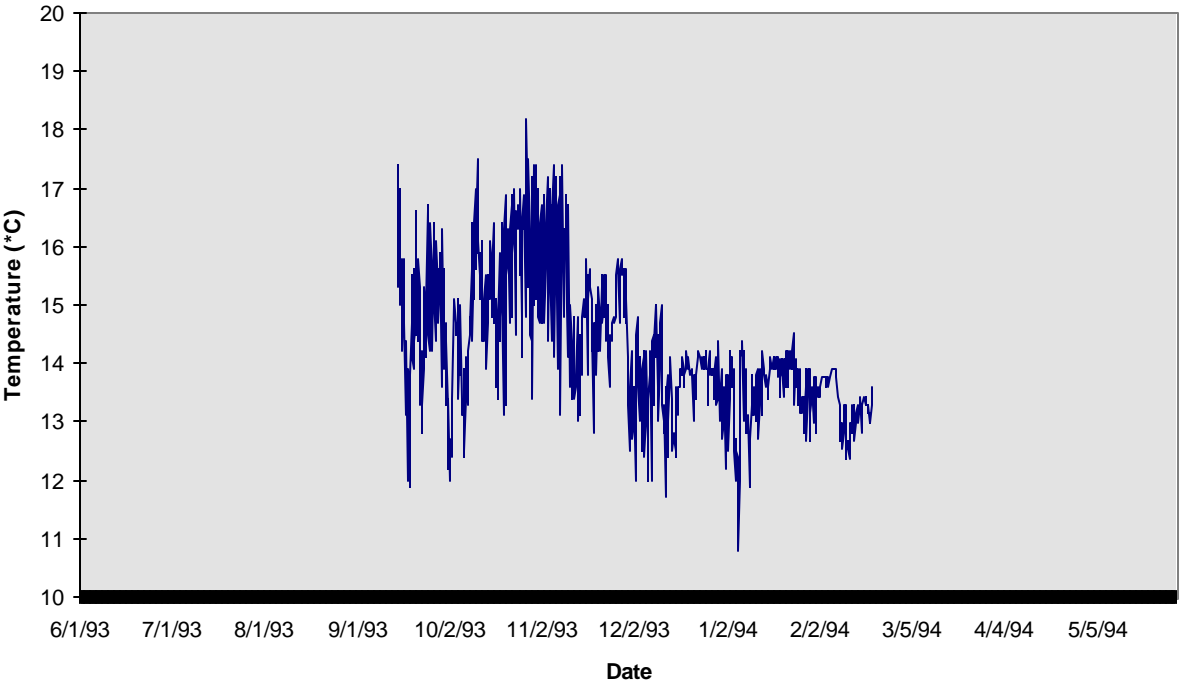
Appendix C. 1994 Temperature data collected at Channel Islands National Park  
Kelp Forest Monitoring Stations by temperature loggers.

Introduction

This appendix contains the temperature data (presented graphically) collected by HOBOTEMPTM temperature loggers that were deployed at all 16 Kelp Forest Monitoring sites. The temperature loggers were deployed at all sites between June 22 and October 1, 1993, except for one at Hare Rock, San Miguel Island, which was deployed on May 21, 1993. Missing data at some sites is the result of technical problems or loss of temperature logger.

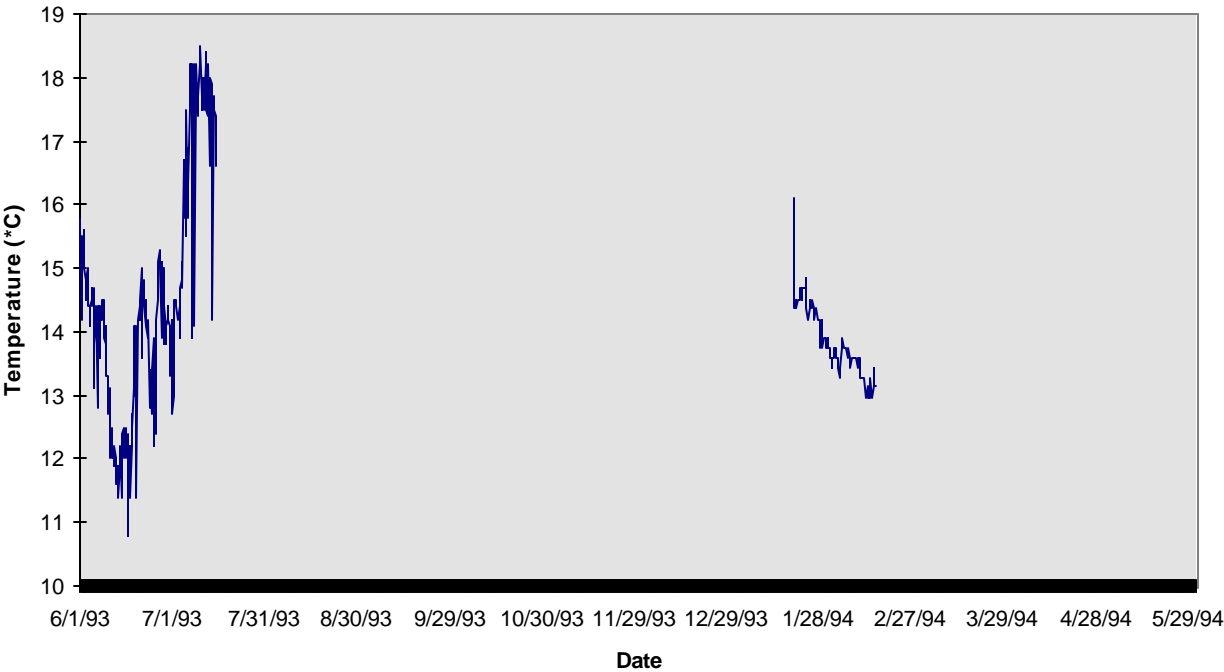
**WYCKOFF LEDGE, SAN MIGUEL ISLAND**

Depth = 13 meters



**HARE ROCK, SAN MIGUEL ISLAND**

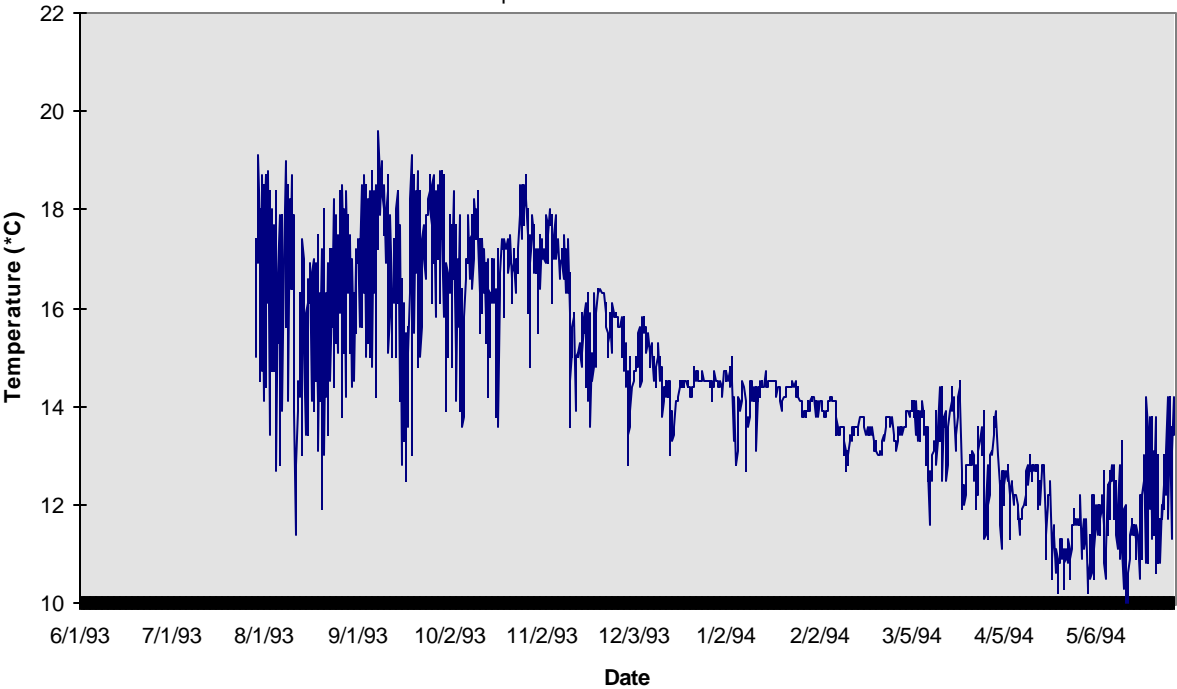
Depth = 5 meters





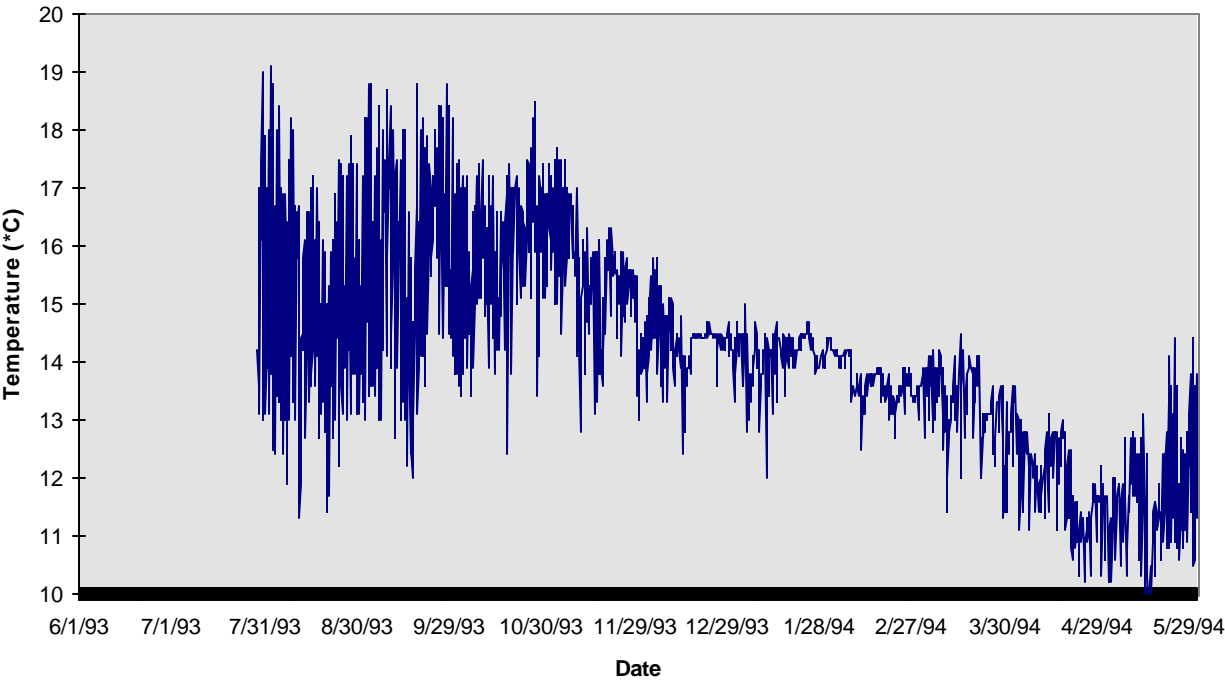
**JOHNSON'S LEE NORTH, SANTA ROSA ISLAND**

Depth = 11 meters

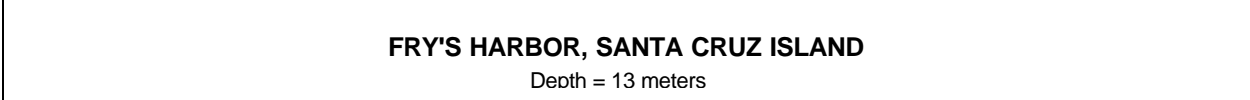
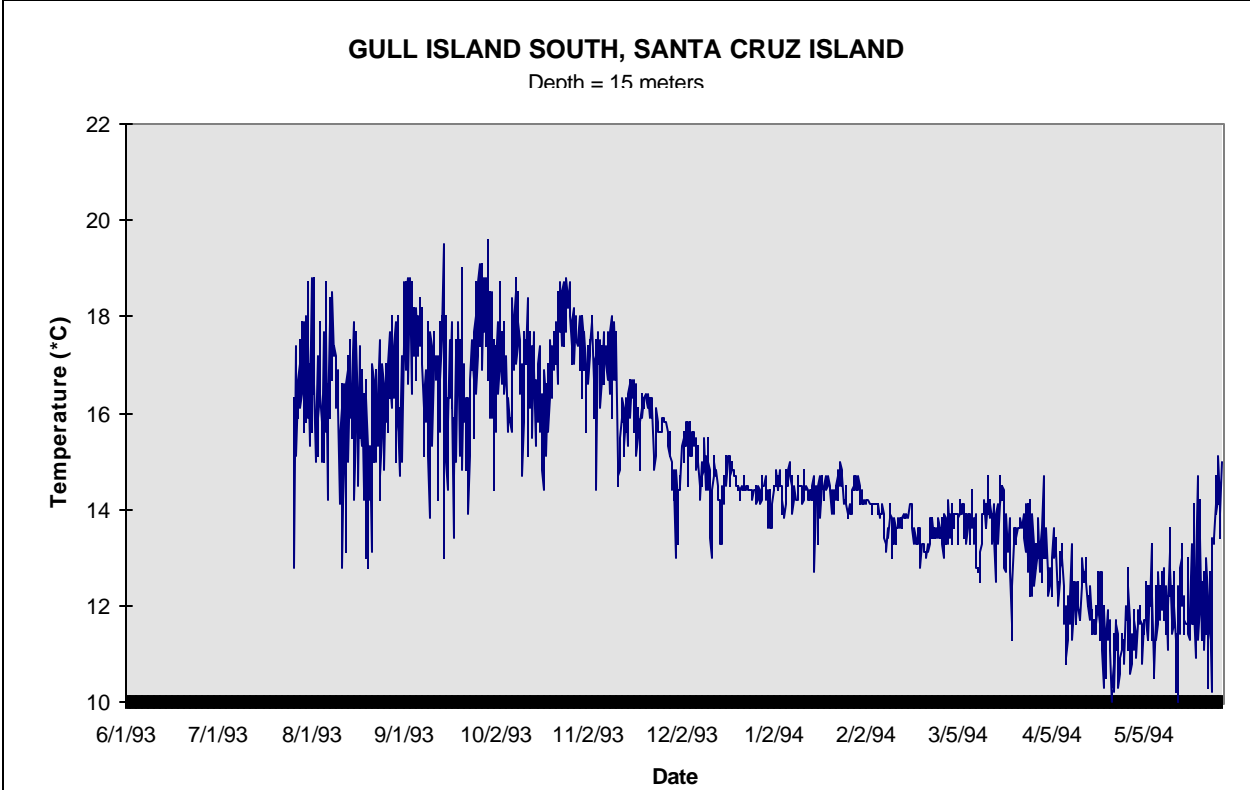
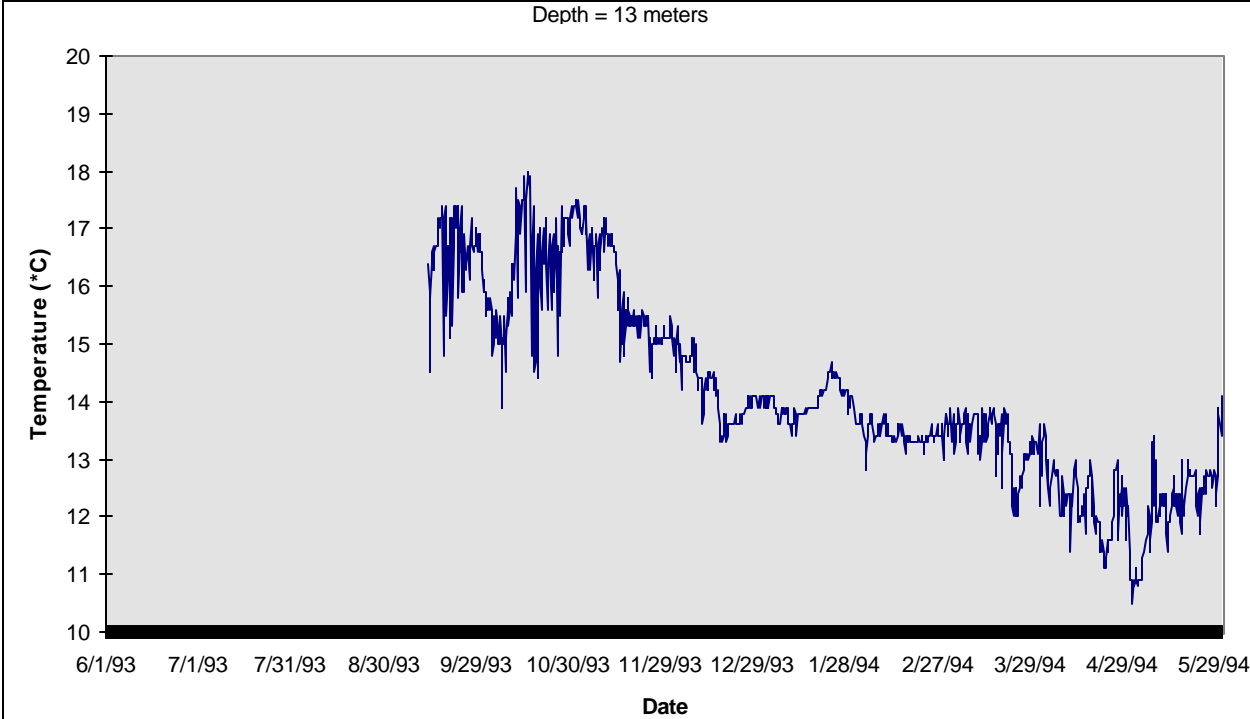


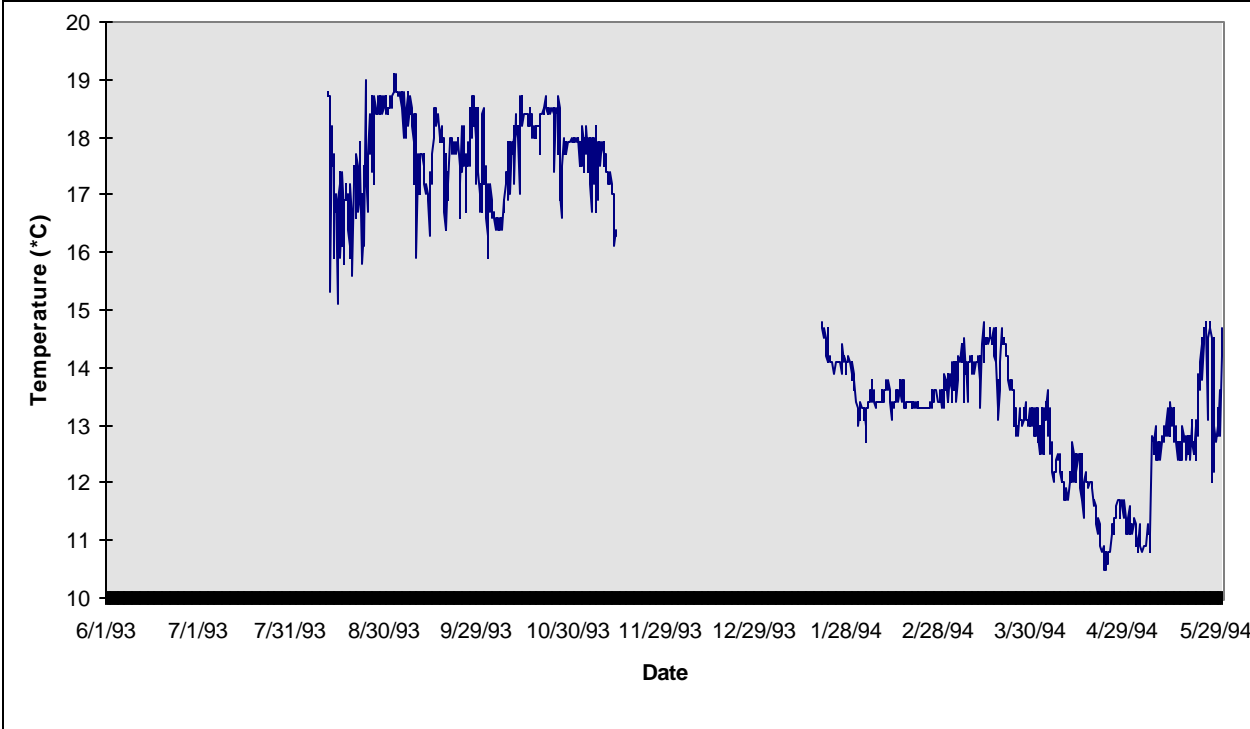
**JOHNSON'S LEE SOUTH, SANTA ROSA ISLAND**

Depth = 16 meters

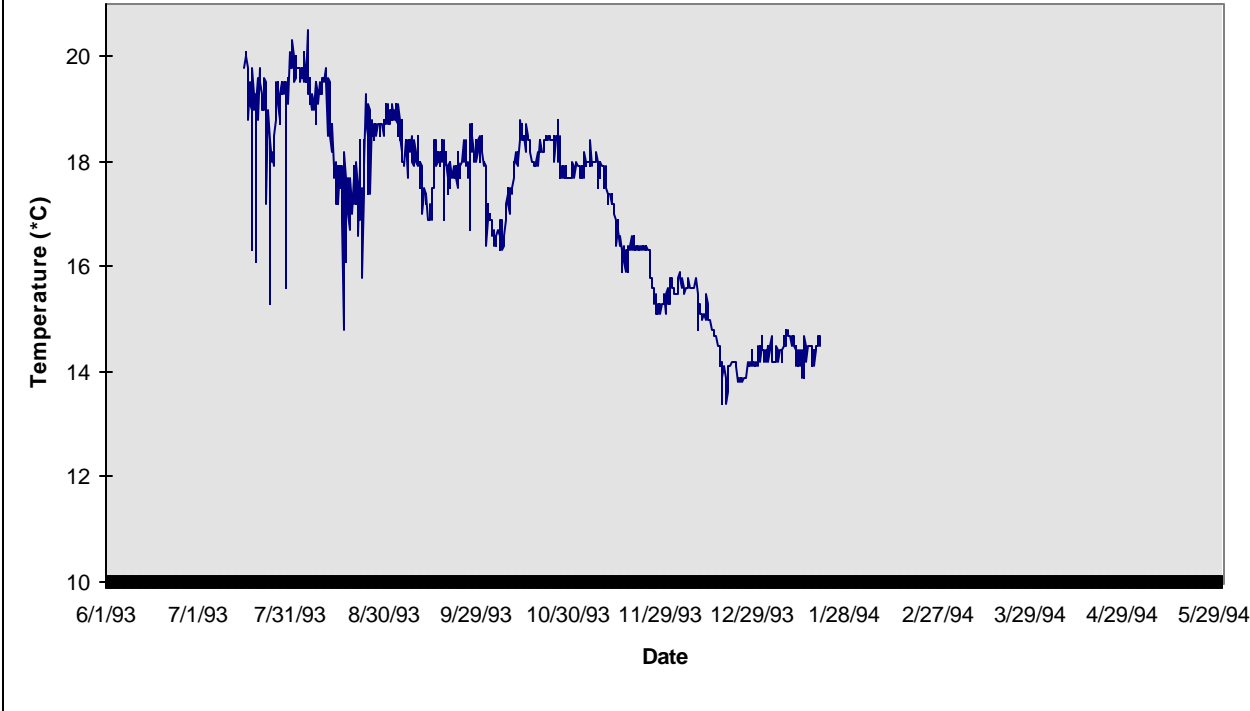


**RODES REEF, SANTA ROSA ISLAND**



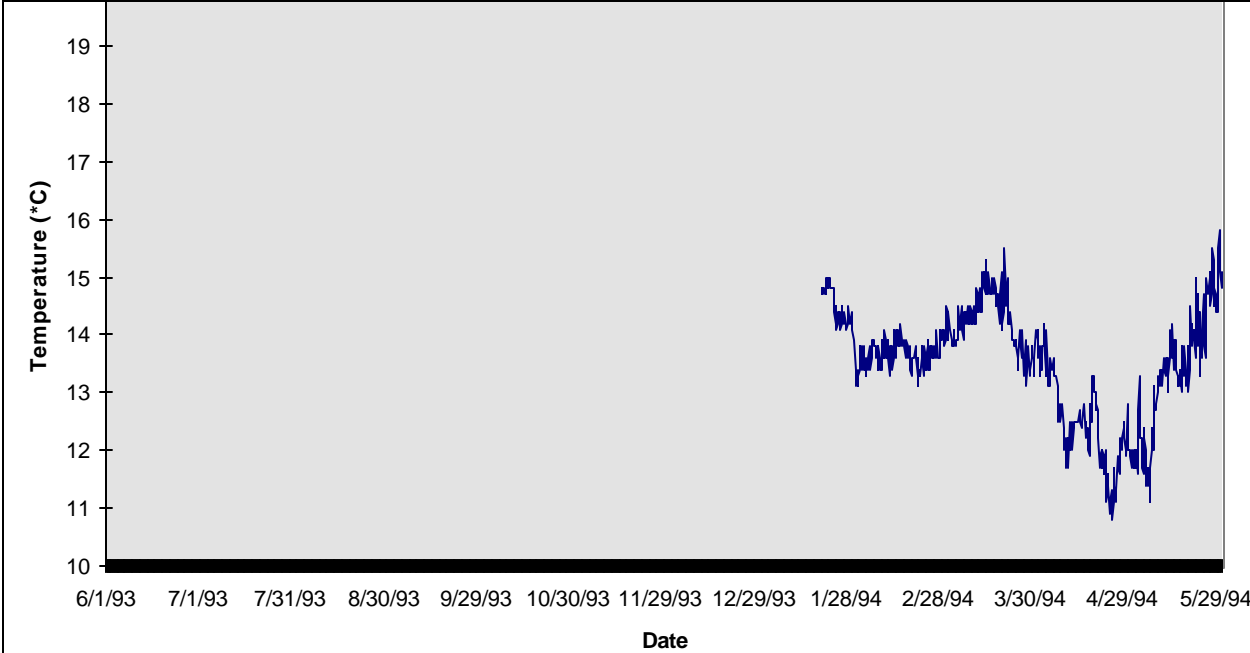


**PELICAN BAY, SANTA CRUZ ISLAND**  
Depth = 8 meters



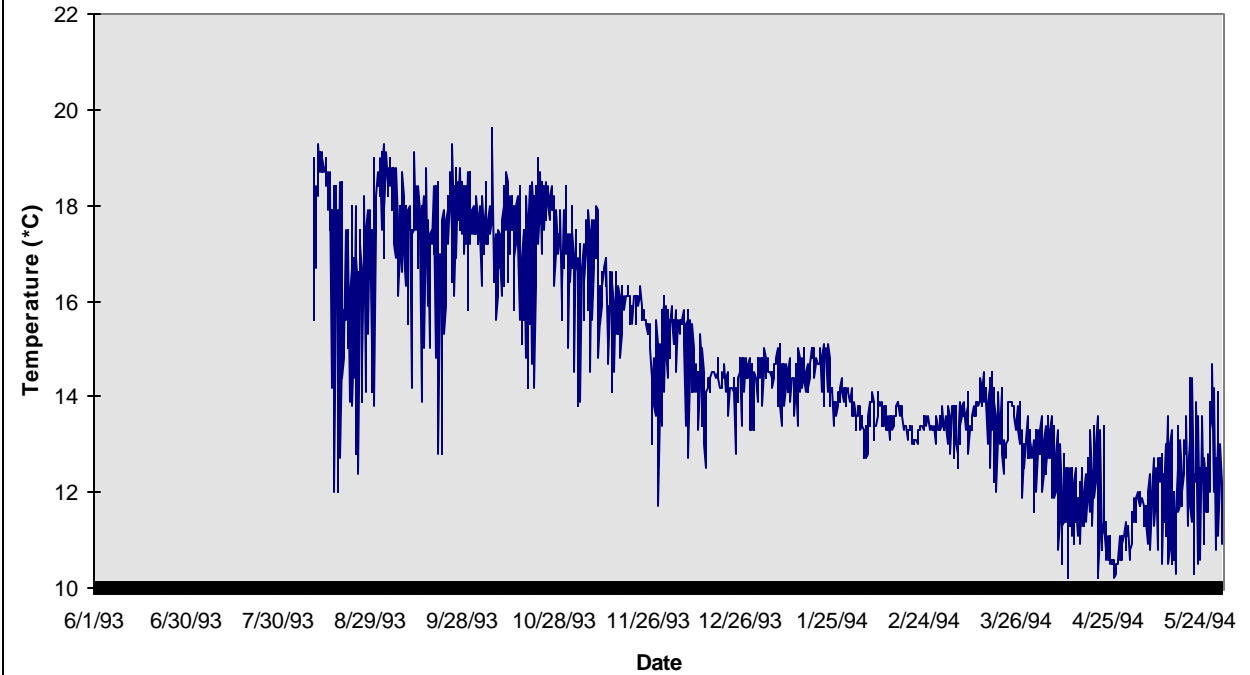
**SCORPION'S ANCHORAGE, SANTA CRUZ ISLAND**  
Depth = 5 meters





**YELLOW BANKS, SANTA CRUZ ISLAND**

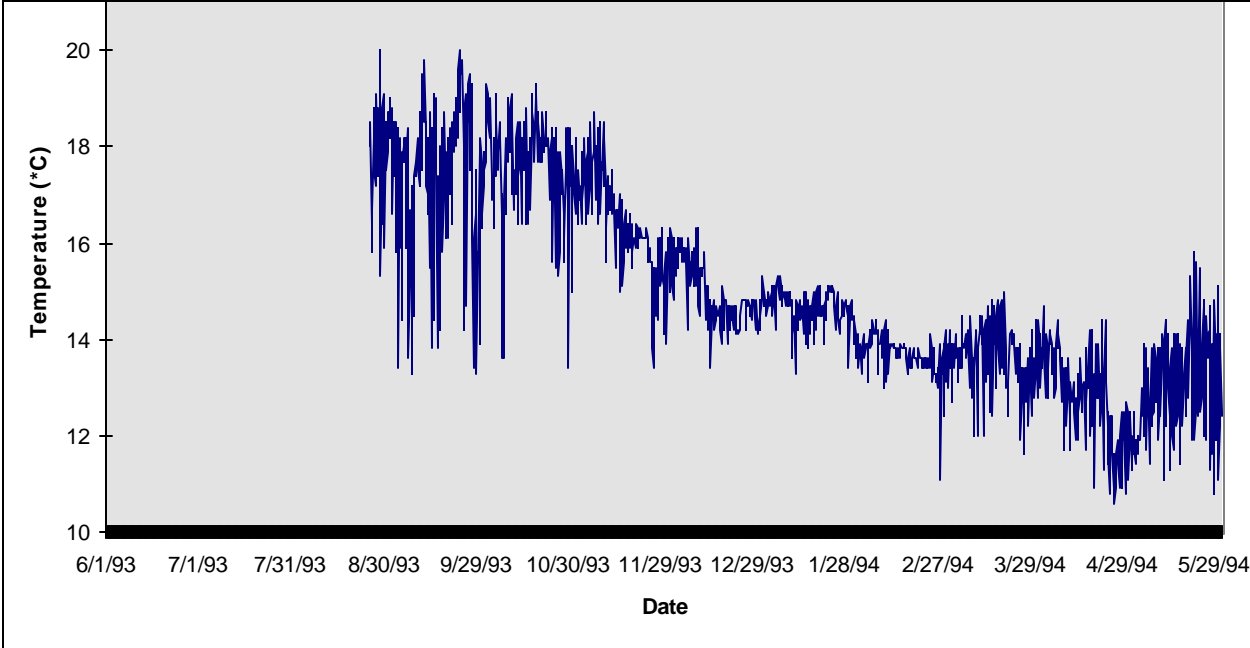
Depth = 15 meters



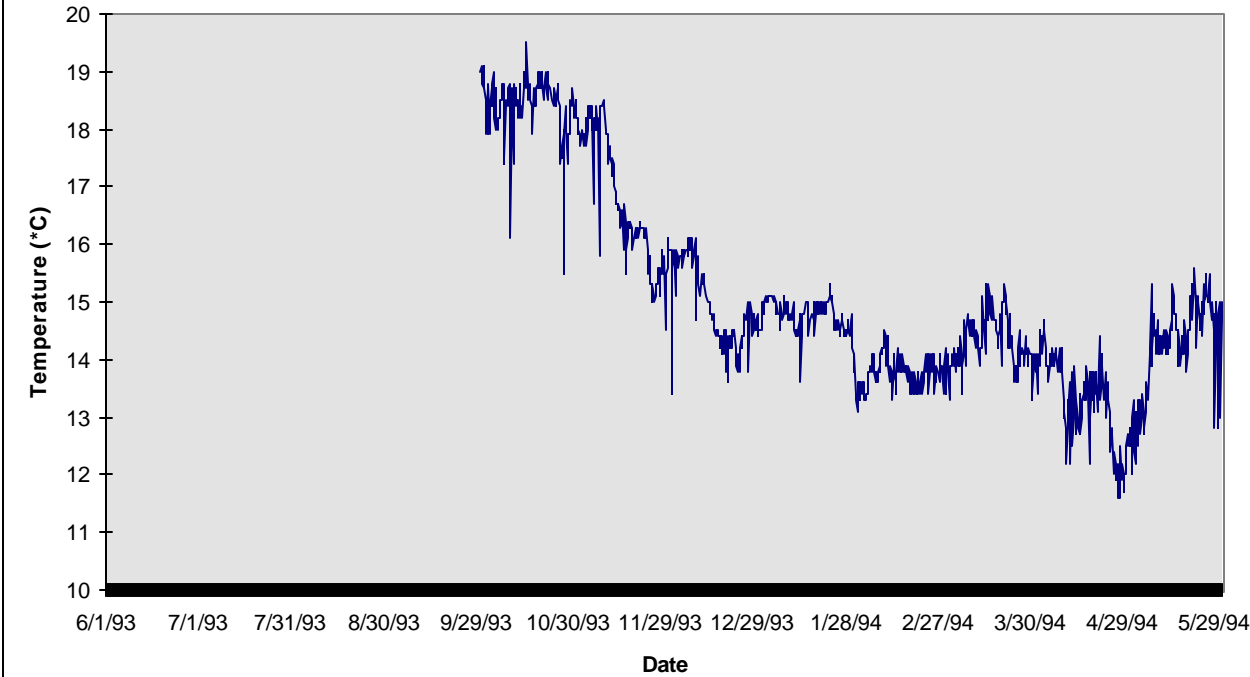
**ADMIRAL'S REEF, ANACAPA ISLAND**

Depth = 16 meters





**CATHEDRAL COVE, ANACAPA ISLAND**  
Depth = 6 meters



**LANDING COVE, ANACAPA ISLAND**  
Depth = 5 meters



